NAiS

FP Σ User's Manual

Matsushita Electric Works, Ltd.

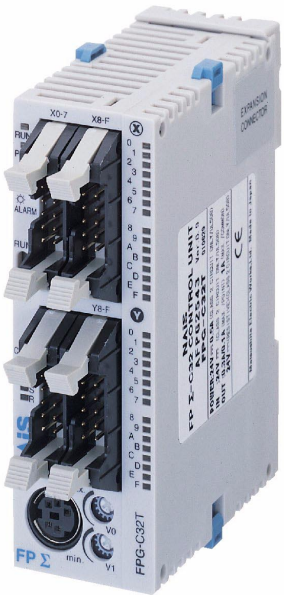
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NAiS

PROGRAMMABLE CONTROLLER

FP SERIES FP Σ

User's Manual



Smart Solutions by NAiS

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Before You Start

Installation environment

Do not use the FPΣ unit where it will be exposed to the following:

- **Direct sunlight and ambient temperatures outside the range of 0°C to 55°C/32°F to 131°F.**
- **Ambient humidity outside the range of 30% to 85% RH and sudden temperature changes causing condensation.**
- **Inflammable or corrosive gas.**
- **Excessive vibration or shock.**
- **Excessive airborne dust, metal particles or salts.**
- **Water or oil in any form including spray or mist.**
- **Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda.**
- **Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges.**

Static electricity

- **Before touching the unit, always touch a grounded piece of metal in order to discharge static electricity.**
- **In dry locations, excessive static electricity can cause problems.**

Cleaning

- **Do not use thinner based cleaners because they deform the unit case and fade the colors.**

Power supplies

- **An insulated power supply with an internal protective circuit should be used. The power supply for the control unit operation is a non-insulated circuit, so if an incorrect voltage is directly applied, the internal circuit may be damaged or destroyed.**
- **If using a power supply without a protective circuit, power should be supplied through a protective element such as a fuse.**

Power supply sequence

- **Make sure the power supply of the control unit turns off before the power supply for input and output. If the power supply for input and output is turned off first, the control unit will detect the input fluctuations and may begin an unexpected operation.**

Before turning on the power

When turning on the power for the first time, be sure to take the precautions given below.

- **During installation, check that there are no scraps of wiring, particularly conductive fragments, adhering to the unit.**
- **Verify that the power supply wiring, I/O wiring, and power supply voltage are all correct.**
- **Sufficiently tighten the installation and terminal screws.**
- **Set the mode selector to PROG mode.**

Before entering a program

Be sure to perform a program clear operation before entering a program.

Procedure for FPWIN Pro:

1. **Online –> Online Mode**
2. **Online –> Clear Program and Reset System Register**
3. **Choose OK in the confirmation dialog box**

Procedure for FPWIN GR:

1. **On line –> Online Edit Mode**
2. **Edit –> Clear Program**
3. **Choose Yes in the confirmation dialog box**

Insurance and Security

To prevent the accidental loss of programs, consider the following measures:

- **Backing up projects**
  Back up your projects using the backup or the export function of the tool software, and store the file in a separate location. For further security, you can also print out the entire program documentation.
- **Specifying a password**
  A password can prevent a program from being accidentally overwritten. However, if you forget your password, it will be impossible to overwrite the program even if you want to. Deleting the password in the software will delete the program. Therefore, you should always note your password and keep it in a safe place.

Programming Tools

Programming tool availability by unit type

Programming Tool		Unit Type		Other Requirements
		FPG–C32T FPG–C32TTM	FPG–C32T2 FPG–C28P2 FPG–C24R2 FPG–C32T2TM FPG–C24R2TM	
FPWIN Pro Ver.4 IEC61131–3–compliant software for Windows		YES	YES (Ver.4.01 and later)	Version 4.02 or later is required if used in conjunction with the FPΣ positioning unit.
Software for Windows	FPWIN GR Ver. 2	YES	YES (Ver.2.1 and later)	Version 2.13 or later is required if used in conjunction with the FPΣ positioning unit.
	FPWIN GR Ver. 1	NO	NO	
Software for MS–DOS	NPST–GR Ver. 4	NO	NO	
	NPST–GR Ver. 3			
Hand–held programming unit (FP pro–grammer)	AFP1113V2 AFP1114V2	NO	NO	
	AFP1113 AFP1114			
	AFP1111A AFP1112A AFP1111 AFP1112			

Upgrading FPWIN GR

FPWIN GR version 2.1 or later is required to program the FPΣ. If you own FPWIN GR Ver. 1, you will need to purchase the FPWIN GR Ver. 2 upgrade separately.

To upgrade from FPWIN GR Ver. 2.0 to Ver. 2.1, please use the download service at our dedicated programmable logic controller site (http://www.naisplc.com/).

Programming Conventions

The explanations in this manual often utilize FPWIN GR conventions. When using FPWIN Pro for programming, please note theses slight differences:

- Instead of addresses, variable names are used.
- Hexadecimal values are represented by the prefix 16# and not H.
- Decimal values do not require a K prefix.
- Inputs and outputs are labeled slightly differently (e.g. s_Start instead of S for F159)

The FPWIN Pro examples in this manual were designed to parallel the FPWIN GR examples and may thus not be as sophisticated as they could be. Please refer to the online help and programming manuals for examples and explanations tailored to FPWIN Pro.

The sample programs were written in Ladder Diagram. In FPWIN Pro, you can also program in Structured Text, Function Block Diagram, Instruction List, and Sequential Function Chart. Turn to the online help and the programming manual for examples in other programming languages.

The abbreviation “POU” used in the examples means Program Organization Unit. “DUT” stands for Data Unit Type and “GVL” for Global Variable List. These and other terms are explained in the FPWIN Pro online help and reference manual.

FP0 Program Compatibility

If you are using FP0 programs on the FPΣ, please note the following:

- **Pulse output function**
  The following changes have been made to instructions concerning pulse output:

Instruction	For the FP0	For the FPΣ
Automatic trapezoidal acceleration/deceleration control	F168 (SPD1)	F171 (SPDH)
JOG operation	F169 (PLS)	F172 (PLSH)
Data table control	None	F174 (SP0H)
Linear interpolation control (see note)	None	F175 (SPSH)
Circular interpolation control (see note)	None	F176 (SPCH)
PWM output	F170 (PWM)	F173 (PWMH)

Note

Linear and circular interpolation control is not available with the C32T and C32TTM FPΣ control units.

- **Serial data communication function**
  The following changes have been made to instructions concerning serial data communication:

Instruction	For the FP0	For the FPΣ
Serial data communication	F144 (TRNS)	F159 (MTRN)

Note

When using FPWIN Pro with the FPΣ, the F144 (TRNS) instruction will automatically be translated into the F159 (MTRN) instruction, and COM port 1 will be set. With other PLCs, F159 (MTRN) will automatically be translated into F144 (TRNS).
In FPWIN GR, F144 (TRNS) cannot be used with the FPΣ.

Important Symbols

The following symbols are used in this manual:



Whenever the warning triangle is used, especially important safety instructions are given. If they are not adhered to, the results could be:

- **personal injury and/or**
- **significant damage to instruments or their contents, e.g. data**

Note

Contains important additional information or indicates that you should proceed with caution.

Example:

Contains an illustrative example of the previous text section.

Table of Contents

Chapter 1 Overview

1.1 Main Features 1-2
1.1.1 Powerful Control Capabilities 1-2
1.1.2 A Full Range of Communication Functions 1-2
1.1.3 Positioning Control 1-3
1.1.4 Analog Control 1-4
1.2 Unit Types 1-5
1.2.1 FPΣ Control Unit 1-5
1.2.2 FPΣ Expansion Unit 1-5
1.2.3 Units for FP0 and FPΣ 1-5
1.2.4 Communication Cassette 1-5
1.3 Restrictions on Unit Combinations 1-6
1.3.1 Restrictions on FP0 Expansion Units 1-6
1.3.2 Restrictions on the Number of FPΣ Expansion Units 1-7
1.4 Programming Tools 1-8

Chapter 2 Parts and Specifications

2.1 Parts and Functions 2-2
2.1.1 Tool Port Specifications 2-5
2.1.2 Communication Cassette 2-5
2.2 Input Specifications 2-6
2.3 Output Specifications 2-8
2.3.1 Transistor Output Specifications 2-8
2.3.2 Relay Output Specifications 2-10
2.4 Terminal Layout Diagrams 2-11
2.4.1 C32T and C32T2 Control Units 2-11
2.4.2 C28P Control Unit 2-12
2.4.3 C24R2 Control Unit 2-13

Chapter 3 Expansion

3.1 Types of Expansion Units 3-2
3.2 Adding FP0 Units 3-3
3.3 Adding FPΣ Expansion Units 3-4
3.4 Parts and Functions of FPΣ Expansion Unit 3-5
3.5 Specifications of FPΣ Expansion Unit 3-6

Chapter 4 I/O Allocation

4.1 General 4-2
4.1.1 I/O Numbers 4-2
4.2 I/O Allocation for FPΣ Units 4-3
4.2.1 FPΣ Control Unit 4-3
4.2.2 FPΣ Expansion Unit 4-3
4.2.3 FPΣ Positioning Unit 4-3
4.3 I/O Allocation for FP0 Units 4-5
4.3.1 FP0 Expansion Unit 4-5
4.3.2 FP0 Analog I/O Unit 4-5
4.3.3 FP0 A/D Conversion Unit 4-6
4.3.4 FP0 Thermocouple Input Unit 4-6
4.3.5 FP0 I/O Link Unit 4-6

Chapter 5 Installation

5.1 Important Notes 5-2
5.2 Attachment to DIN Rails 5-5
5.3 Installation Using Flat Type Mounting Plate 5-6
5.4 Installation Using Slim 30 Type Mounting Plate 5-8
5.5 Backup Battery 5-10
5.5.1 Installation 5-10
5.5.2 Setting System Registers 5-11
5.5.2.1 Setting the Battery Error Alarm 5-11
5.5.2.2 Specifying the Hold Area 5-12
5.5.3 Lifetime 5-12

Chapter 6 Wiring

6.1 Safety Instructions 6-2
6.2 Wiring of Power Supply 6-4
6.3 Grounding 6-6
6.4 Input Wiring 6-7
6.4.1 Photoelectric and Proximity Sensors 6-7
6.4.2 LED–Equipped Reed Switch 6-8
6.4.3 Two–Wire Type Sensor 6-8
6.4.4 LED–Equipped Limit Switch 6-9
6.5 Output Wiring 6-10
6.5.1 Inductive Loads 6-10
6.5.2 Capacitive Loads 6-11

6.6 Wiring the MIL Connector 6-12
6.7 Wiring the Terminal Block 6-14

Chapter 7 High–Speed Counter and Pulse Output

7.1 Overview 7-2
7.2 Function Specifications and Restrictions 7-4
7.2.1 Specifications 7-4
7.2.2 Restrictions 7-6
7.2.3 Booting Time 7-8
7.3 High–Speed Counter Function 7-9
7.3.1 Types of Input Modes 7-9
7.3.2 Minimum Input Pulse Width 7-10
7.3.3 I/O Allocation 7-11
7.3.4 Instructions 7-12
7.3.4.1 High–Speed Counter Control Instruction F0 7-12
7.3.4.2 Elapsed Value Write and Read Instruction F1 7-14
7.3.4.3 Target Value Match ON Instruction F166 7-16
7.3.4.4 Target Value Match OFF Instruction F167 7-17
7.3.5 Sample Programs 7-19
7.3.5.1 Positioning Operations With Single–Speed Inverter 7-19
7.3.5.2 Positioning Operations With Double–Speed Inverter 7-22
7.4 Pulse Output Function 7-26
7.4.1 Pulse Output Methods 7-27
7.4.2 I/O Allocation 7-28
7.4.3 Control Mode 7-29
7.4.4 Instructions 7-30
7.4.4.1 Positioning Control Instruction F171 – Trapezoidal Control 7-30
7.4.4.2 Positioning Control Instruction F171 – Home Return 7-33
7.4.4.3 Pulse Output Instruction F172 – JOG Operation 7-37
7.4.4.4 Positioning Control Instruction F174 – Data Table Control 7-40
7.4.4.5 Pulse Output Instruction F175 – Linear Interpolation 7-44
7.4.4.6 Pulse Output Instruction F176 – Circular Interpolation 7-48
7.4.4.7 Pulse Output Control Instruction F0 7-57
7.4.4.8 Elapsed Value Write and Read Instruction F1 7-59

7.4.5 Sample Programs 7-61
7.4.5.1 Incremental Position Control Operation: Plus Direction 7-63
7.4.5.2 Incremental Position Control Operation: Minus Direction 7-66
7.4.5.3 Absolute Position Control Operation 7-69
7.4.5.4 Home Return Operation: Minus Direction 7-72
7.4.5.5 Home Return Operation: Plus Direction 7-75
7.4.5.6 JOG Operation: Plus Direction 7-78
7.4.5.7 JOG Operation: Minus Direction 7-80
7.4.5.8 Emergency Stop: Over Limit 7-81
7.4.6 Sample Programs for Circular Interpolation 7-82
7.4.6.1 Pass Position Setting Method 7-82
7.4.6.2 Center Position Setting Method 7-86
7.4.6.3 Interpolation Control (Linear and Circular) 7-90
7.4.6.4 Continue Mode Method 7-97
7.5 PWM Output Function 7-102
7.5.1 PWM Output Instruction F173 7-102

Chapter 8 Communication Cassette

8.1 Communication Modes of the FPΣ 8-2
8.1.1 Computer Link 8-2
8.1.2 General–Purpose Serial Communication 8-3
8.1.3 PLC Link 8-4
8.2 Device Description 8-5
8.2.1 Cassette Types 8-5
8.2.2 COM Ports 8-6
8.2.3 Communication Specifications 8-7
8.3 Installation 8-10
8.4 Wiring 8-11
8.4.1 Wiring Equipment 8-11
8.4.2 Wiring Method 8-12
8.5 Cables 8-13

Chapter 9 Computer Link

9.1 Overview 9-2
9.1.1 Outline of Operation 9-2
9.1.2 Format of Command and Response 9-3
9.1.3 Commands 9-6
9.1.4 Setting Communication Parameters 9-7
9.2 Connection Examples 9-9
9.2.1 1:1 Communication With Computer 9-9
9.2.2 1:1 Communication With Programmable Display GT10/GT30 9-11
9.3 1:N Communication 9-14
9.3.1 Setting System Registers and Unit Numbers 9-15
9.3.2 Connection with External Devices 9-18

Chapter 10 General–Purpose Serial Communication

10.1 Overview 10-2
10.1.1 Outline of Operation 10-2
10.1.2 Programming Example 10-3
10.1.3 Setting Communication Parameters 10-4
10.2 Communication with External Devices 10-8
10.2.1 Sending Data to External Devices 10-8
10.2.2 Receiving Data from External Devices 10-13
10.2.2.1 Performing Repeated Reception of Data 10-17
10.3 Connection Examples 10-18
10.3.1 1:1 Communication With Micro–Imagechecker 10-18
10.3.2 1:1 Communication With FP Series PLC 10-24
10.4 Data Format 10-32
10.5 1:N Communication 10-34
10.6 Flag Operation in Serial Communication 10-35
10.6.1 Header: No–STX, Terminator: CR 10-35
10.6.2 Header: STX, Terminator: ETX 10-36
10.7 Changing Communication Mode of COM Port 10-38

Chapter 11 PLC Link

11.1 Overview 11-2
11.2 Setting Communication Parameters 11-4
11.2.1 Communication Mode 11-4
11.2.2 Unit Numbers 11-5
11.2.3 Link Area Allocation 11-9
11.2.3.1 Example 11-10
11.2.3.2 Partial Use of Link Areas 11-11
11.2.3.3 Precautions 11-12
11.2.4 Setting the Largest Station Number for a PLC Link 11-13
11.3 Monitoring 11-14
11.4 Connection Example 11-15
11.5 PLC Link Response Time 11-18
11.5.1 Reducing the Transmission Cycle Time 11-20
11.5.2 Error Detection Time for Transmission Assurance Relays 11-21

Chapter 12 Other Functions

12.1 Analog Potentiometer 12-2
12.1.1 Application Example 12-3
12.2 Thermistor Input Functions 12-4
12.2.1 Overview of Thermistor Input 12-4
12.2.2 Loading Thermistor Temperature Data 12-6
12.3 Clock/Calendar Function 12-8
12.3.1 Area for Clock/Calendar Function 12-8
12.3.2 Setting of Clock/Calendar Function 12-9
12.3.3 Sample Program for Fixed Schedule and Automatic Start . . . 12-11

Chapter 13 Self–Diagnostic and Troubleshooting

13.1 Self–Diagnostic Function 13-2
13.1.1 LED Display for Status Condition 13-2
13.1.2 Operation on Error 13-2
13.2 Troubleshooting 13-4
13.2.1 ERROR/ALARM LED is Flashing 13-4
13.2.2 ERROR/ALARM LED is ON 13-7
13.2.3 All LEDs are OFF 13-7
13.2.4 Diagnosing Output Malfunction 13-8
13.2.5 A Protect Error Message Appears 13-10
13.2.6 PROG Mode does not Change to RUN 13-11
13.2.7 A Transmission Error has Occurred 13-11

Appendix A Specifications, Dimensions

A.1 General Specifications A-2
A.2 Performance Specifications A-4
A.3 Dimensions A-9
A.3.1 Control Unit A-9
A.3.2 Expansion Unit A-10

Appendix B Programming Information

B.1 General Note B-2
B.2 Relays, Memory Areas and Constants B-3
B.3 System Registers B-6
B.3.1 Precautions When Setting System Registers B-6
B.3.2 Types of System Registers B-6
B.3.3 Checking and Changing System Registers B-7
B.3.4 Table of System Registers B-8
B.4 Table of Special Internal Relays B-13
B.5 Table of Special Data Registers B-20
B.6 Table of Error Codes B-35
B.6.1 Syntax Check Error Codes B-35
B.6.2 Self–Diagnostic Error Codes B-36
B.7 Table of Instructions B-37
B.7.1 Table of Basic Instructions B-37
B.7.2 Table of High–Level Instructions B-44
B.8 MEWTOCOL–COM Communication Commands B-60
B.9 Hexadecimal/Binary/BCD B-61
B.10 ASCII Codes B-62

Index

Record of Changes

Chapter 1

Overview

1.1 Main Features

The FPΣ (Sigma) is a small–size PLC (programmable logic controller) with great performance. It can be expanded by up to three expansion or intelligent units. The controller uses the comprehensive Matsushita instruction set and is programmed with FPWIN GR 2.0 or higher or with FPWIN Pro 4.0 or higher. With FPWIN Pro, programming according to IEC 61131–3 is also possible.

The FPΣ offers the following features and functions:

1.1.1 Powerful Control Capabilities

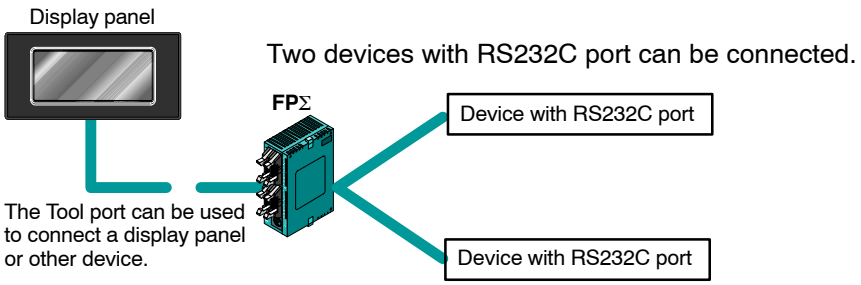
All of the functions of a mid–scale PLC are packed into the compact body size of the 32–point type FP0. A program capacity of 12 k steps is provided as a standard feature, so you never have to worry about how much memory is left as you are programming. In addition, 32 k words are reserved for data registers, so large volumes of data can be compiled and multiple operations can be processed without running out of memory.

1.1.2 A Full Range of Communication Functions

Using the Tool port (RS232C) provided as a standard feature on the main unit, communication can be carried out with a display panel or a computer. Additionally, communication cassettes with RS232C and RS485 interfaces are available as an option. Installing a 2–channel RS232C type communication cassette in the FPΣ makes it possible to connect two devices with an RS232C port. A full lineup of communication functions means you can also work with 1:N communication and the PLC link function (up to 16 units).

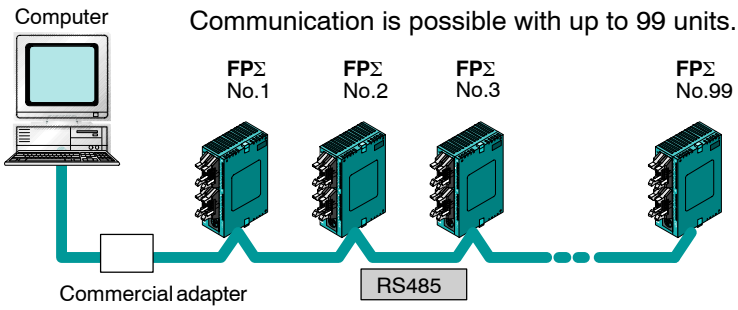
Controlling two devices having an RS232C port with one FPΣ

Using the 2–channel RS232C type communication cassette


Display panel
Two devices with RS232C port can be connected.
FPΣ
Device with RS232C port
Device with RS232C port
The Tool port can be used to connect a display panel or other device.

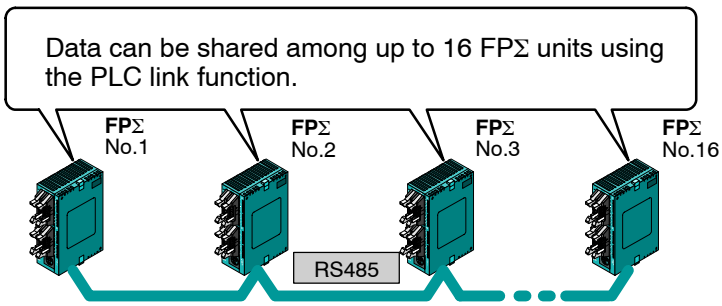
1:N communication with up to 99 stations (units)

Using the 1–channel RS485 type communication cassette



Sharing data among multiple PLCs using the PLC link function

Using the 1–channel RS485 type communication cassette

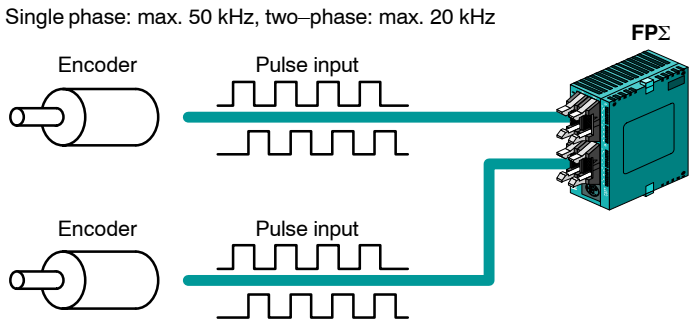


1.1.3 Positioning Control

A high–speed counter and a pulse output function are provided as standard features. The pulse output function supports frequencies of up to 100 kHz, which allows positioning control using a stepping or a servo motor.

Measurement using high–speed counter

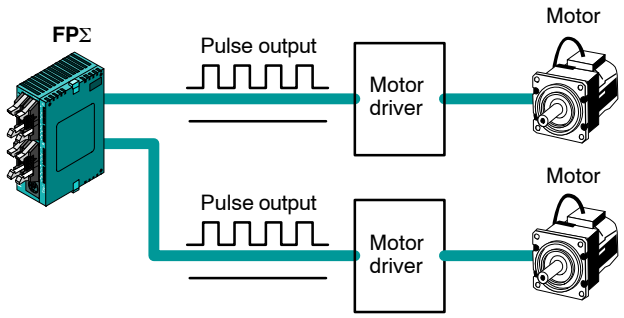
Increment input mode, decrement input mode, 2–phase input mode, individual input mode, and direction discrimination mode are supported.



Positioning control based on pulse output

Pulse/direction and clockwise/counter–clockwise output are supported.

1–channel: max. 100 kHz, 2–channel: max. 60 kHz



1.1.4 Analog Control

An analog potentiometer (volume dial) is provided as a standard feature. It can be used in applications such as analog timers and does not require a programming tool. An analog unit is also available as intelligent unit.

1.2 Unit Types

The following units are available for the FPΣ:

1.2.1 FPΣ Control Unit

Name	Number of I/O points	Part no.
FPΣ control unit	Input: 16 points/transistor output: 16 points NPN	FPG–C32T
	Input: 16 points/transistor output: 16 points NPN	FPG–C32T2
	Input: 16 points/transistor output: 12 points PNP	FPG–C28P2
	Input: 16 points/relay output: 8 points	FPG–C24R2
FPΣ control unit with thermistor input function	Input: 16 points/transistor output: 16 points NPN	FPG–C32TTM
	Input: 16 points/transistor output: 16 points NPN	FPG–C32T2TM
	Input: 16 points/relay output: 8 points	FPG–C24R2TM

It is not possible to expand the FPG–C32T or FPG–C32TTM FPΣ control unit with the FPΣ expansion unit. (These units are not currently available in Europe.)

1.2.2 FPΣ Expansion Unit

Name	Number of I/O points	Part no.
FPΣ expansion I/O unit	Input: 32 points/transistor output: 32 points NPN	FPG–XY64D2T
FPΣ positioning unit	Transistor output: 1–axis type	FPG–PP11
	Transistor output: 2–axis type	FPG–PP21
	Line driver output: 1–axis type	FPG–PP12
	Line driver output: 2–axis type	FPG–PP22
FPΣ expansion data memory unit	256 k byte	FPG–EM1

It is not possible to expand the FPG–C32T or FPG–C32TTM FPΣ control unit with the FPΣ expansion unit. (These units are not currently available in Europe.)

1.2.3 Units for FP0 and FPΣ

It is possible to use the FP0–series I/O expansion units, high–level units, and power units with the FPΣ.

1.2.4 Communication Cassette

A detachable communication cassette (optional) should be used when using functions such as computer link, serial data communication, and PLC link.

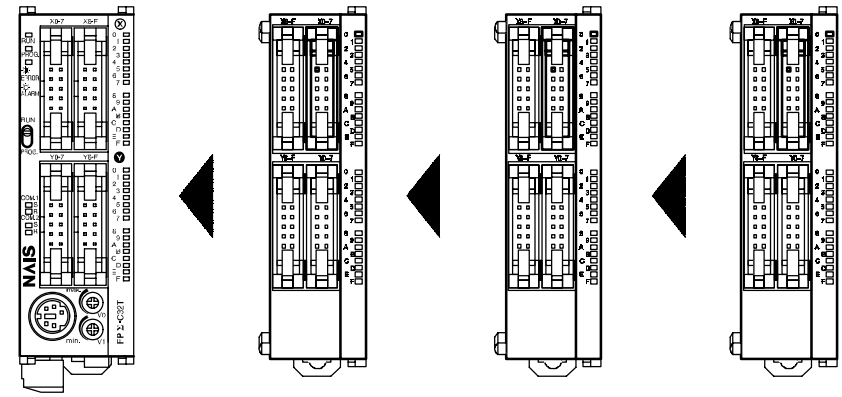
Name	Description	Part no.
FPΣ communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1 : 1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2
FPΣ communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1 : N computer links (C–NET), general–purpose serial communication, and a PLC link.	FPG–COM3

1.3 Restrictions on Unit Combinations

By adding expansion units, the number of I/O points can be increased. However, the maximum number of expansion units per control unit is limited.

1.3.1 Restrictions on FP0 Expansion Units

A maximum of three FP0 expansion units or FP0 intelligent units (or a combination of the two) can be connected on the right side of the FPΣ control unit. A combination of relay output types and transistor output types is also possible.



(Maximum expansion: 3 units)

FPΣ control unit | Expansion/ intelligent unit 1 | Expansion/ intelligent unit 2 | Expansion/ intelligent unit 3

Controllable I/O points

Type of control unit	Number of I/O points on control unit	Number of I/O points when using FP0 expansion units
FPG–C32T/FPG–C32TTM **FPG–C32T2/FPG–C32T2TM**	32 points	max. 128 points
FPG–C28P2	28 points	max. 124 points
FPG–C24R2/FPG–C24R2TM	24 points	max. 120 points *1

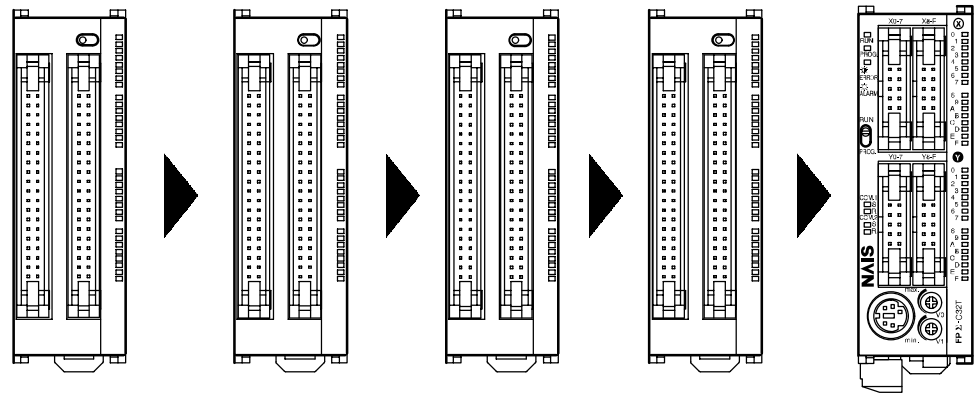
*1. Number of points is when combined with FP0 transistor–type expansion unit.

Note

Install the FP0 Thermocouple Unit on the right side of other expansion units.

1.3.2 Restrictions on the Number of FPΣ Expansion Units

Up to four dedicated FPΣ expansion units can be added on the left of the FPΣ. The 64–point expansion unit has 32 inputs, and 32 NPN transistor outputs.



Controllable I/O Points

Type of control unit	Number of I/O points on control unit	Number of I/O points when using FPΣ expansion units
FPG–C32T2/FPG–C32T2TM	32 points	max. 288 points *1 *2
FPG–C28P2	28 points	max. 284 points *2
FPG–C24R2/FPG–C24R2TM	24 points	max. 280 points *2

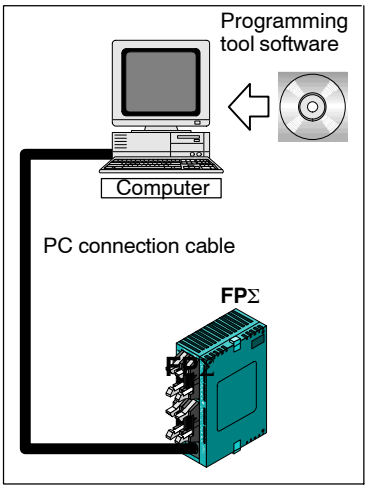
*1. The FPG–C32T and FPG–C32TTM cannot be used as FPΣ expansion units.
*2. Number of points is when combined with FPΣ NPN type expansion unit.

1.4 Programming Tools

Tools needed for programming

① **Programming tool software**
To program the FPΣ, use the Windows software FPWIN Pro Ver. 4.0 or higher or FPWIN GR Ver. 2.0 or higher.
FPWIN GR Ver. 1x, NPST–GR, and FP Programmer cannot be used.

② **PC connection cable**
Cable needed to connect the FPΣ and the computer.



Standard ladder diagram tool software "FPWIN–GR Ver.2"

Type of software		OS (Operating system)	Hard disk capacity	Part No.	Product No.
FPWIN–GR Ver. 2 English–language menu	English–language software	Windows 95/98/ Me/2000/NT (Ver. 4.0 or later)	30MB or more	FPWINGRF–EN2	AFPS10520
	Upgrade (to upgrade from Ver.1.1)			FPWINGRR–EN2	AFPS10520R

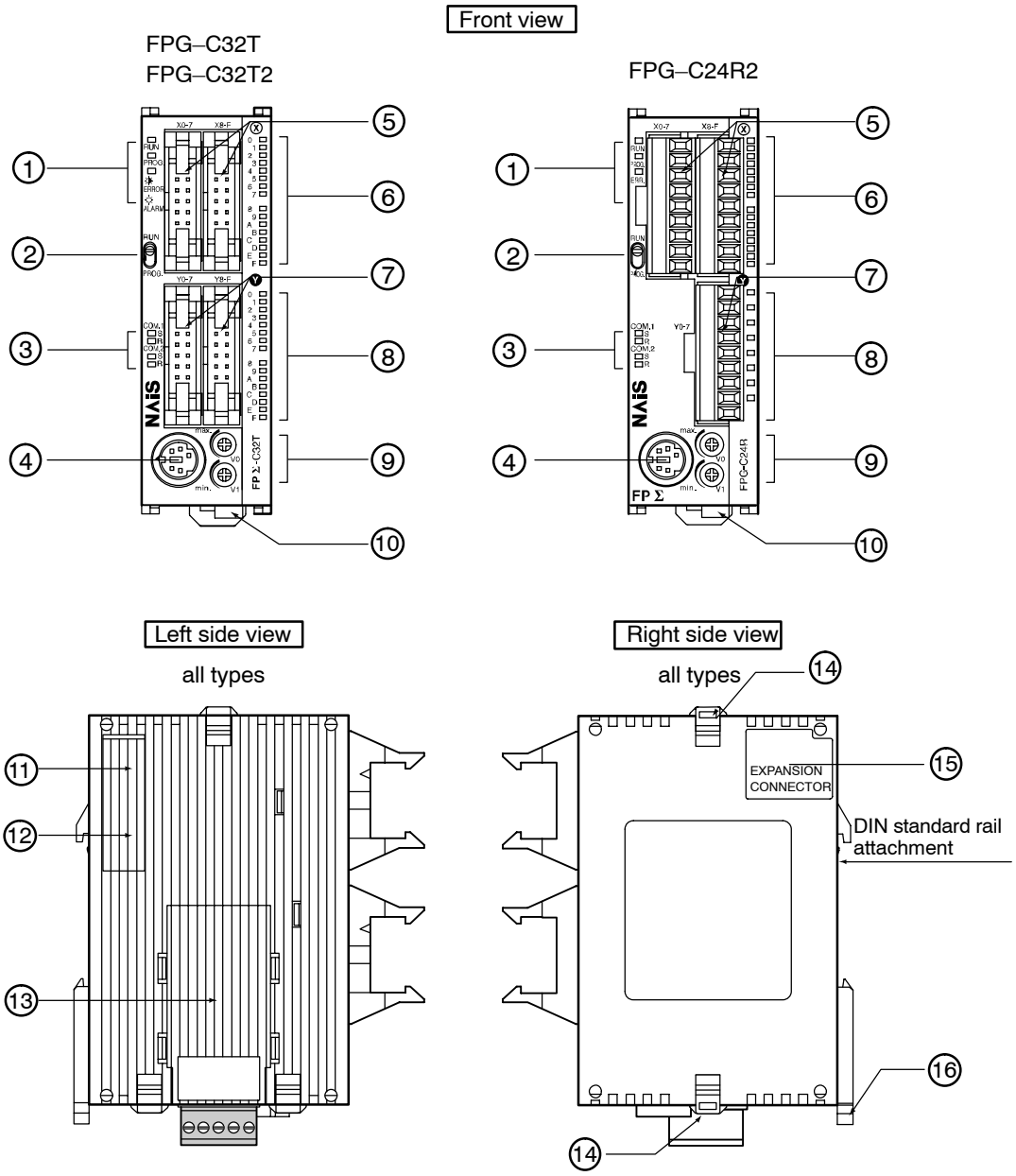
Conforms to IEC61131–3 programming tool software "FPWIN–Pro Ver.4"

Type of software		OS (Operating system)	Hard disk capacity	Part No.	Product No.
FPWIN Pro Ver. 4 Full type (for all type FP series PLC)	English–language menu	Windows 95/98/ Me/2000/NT (Ver. 4.0 or later)	100MB or more	FPWINPROF–EN4	AFPS50540
FPWIN Pro Ver. 4 Small type (for FP0, FPΣ, FP1, and FP–M)	English–language menu			FPWINPROS–EN4	AFPS51540

Chapter 2

Parts and Specifications

2.1 Parts and Functions



① Status indicator LEDs

Display the current mode of operation or the occurrence of an error.

LED	LED and operation status
RUN (green)	Lights when in RUN mode and indicates that the program is being executed.
	Flashes during forced input/output. (The RUN and PROG LEDs flash alternately.)
PROG. (green)	Lights when in PROG mode and indicates that operation has stopped.
	Flashes during forced input/output. (The RUN and PROG LEDs flash alternately.)
ERROR/ALARM (red)	Flashes when an error is detected during the self-diagnostic function.
	Lights if a hardware error occurs, or if operation slows because of the program, and the watchdog timer is activated.

② RUN/PROG mode switch

Used to change the operation mode of the PLC.

Switch position	Operation mode
RUN (upward)	Sets RUN mode. The program is executed and operation begins.
PROG. (downward)	Sets PROG mode. Operation stops. In this mode, programming with tools is possible.

When performing remote switching with the programming tool, the position of the mode switch and the actual mode of operation may differ. Verify the mode with the status indicator LED. Otherwise, restart the FPΣ and change the mode of operation using the RUN/PROG mode switch.

③ Communication status LEDs

Display the communication status of the COM 1 and COM 2 ports.

LED			LED and communication status
COM 1	**S**	**Transmitted data monitor**	Flashes while data is being transmitted
			Goes out when no data is being transmitted
	R	**Received data monitor**	Flashes while data is being received
			Goes out when no data is being received
COM 2	**S**	**Transmitted data monitor**	Flashes while data is being transmitted (Always on for RS232C 1 channel type)
			Goes out when no data is being transmitted
	R	**Received data monitor**	Flashes while data is being received (If RS and CS terminals connected, on when RS232C 1 channel type is in use)
			Goes out when no data is being received

④ Tool port (RS232C)

Used to connect a programming tool.

⑤ Input connector (10 pins × 2)

⑥ Input indicator LEDs

⑦ Output connector (10 pins × 2)

⑧ Output indicator LEDs

⑨ Analog potentiometer (analog dial) (excluding units with thermistor input function)

Turning this dial changes the values of special data registers DT90040 and DT90041 within the range of K0 to K1000. The dial can be used for analog timers and other applications.

⑩ Power supply connector (24 V DC)

The power supply is connected using the power supply cable (AFP0581) that comes with the unit.

⑪ Left–side connector for FPΣ expansion units

Connects a dedicated FPΣ expansion unit to the internal circuit of the control unit. Only the FPG–C32T and FPG–C32TTM control units are not equipped with this connector.

⑫ Unit number (station number) setting switch

The unit or station number must be specified when using the communication functions provided by the optional communication cassette.



The unit number (station number) setting switch is located under the cover labelled “EXPANSION CONNECTOR” on the left side of the unit. Specify the unit (station) number using the selector switch and the dial.

⑬ Communication cassette (option)

Optional cassette type adapter used for communication. Any one of the following cassette types may be installed:

- 1–channel RS232C type
- 2–channel RS232C type
- 1–channel RS485 type

⑭ Expansion hook

Used to secure expansion units. The hook is also used for installation on the flat type mounting plate (AFP0804).

⑮ Right–side connector for FP0 expansion units

Connects an FP0 expansion unit to the internal circuit of the control unit.

⑯ DIN rail attachment lever

The FPΣ unit is easily attached to a DIN rail. The lever is also used for installation on the slim 30 type mounting plate (AFP0811).

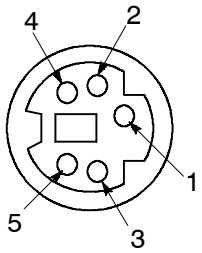


Tip

See page 12-4 for the functions of units with a thermistor input function.

2.1.1 Tool Port Specifications

A commercial mini–DIN 5–pin connector is used for the Tool port on the control unit.



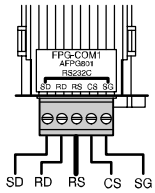
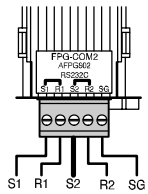
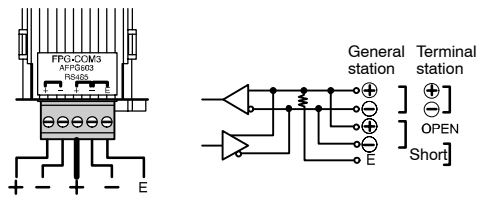
Pin no.	Signal name	Abbreviation	Signal direction
1	Signal Ground	SG	—
2	Transmitted Data	SD	Unit → External device
3	Received Data	RD	Unit ← External device
4	(Not used)	—	—
5	+ 5 V	+ 5 V	Unit → External device

The factory settings are shown below. They can be changed in the system registers.

– Baud rate . . . . . 9600 bit/s
– Character bit . . . 8 bit
– Parity check . . . . Odd parity
– Stop bit length . . 1 bit

2.1.2 Communication Cassette

For the detachable communication cassette (optional) there are three different types available.

Type	Applicable communication function	Terminal layout diagram
1–channel RS232C type	Computer link General purpose serial communication	 SD: Transmitted Data (Output) RD: Received Data (Input) RS: Request to Send (Output) CS: Clear to Send (Input) SG: Signal Ground
2–channel RS232C type	Computer link General purpose serial communication	 S1: Transmitted Data (Output) (COM 1) R1: Received Data (Input) (COM 1) S2: Transmitted Data (Output) (COM 2) R2: Received Data (Input) (COM 2) SG: Signal Ground (COM 1 and 2)
1–channel RS485 type	Computer link General purpose serial communication PLC link	

2.2 Input Specifications

The input specifications below apply to all types of the FPΣ control unit.

Item		Description
Insulation method		Optical coupler
Rated input voltage		24 V DC
Operating voltage range		21.6 to 26.4 V DC
Rated input current		For X0, X1, X3, X4: approx. 8 mA For X2, X5 to X7: approx. 4.3 mA For X8 to XF: approx. 3.5 mA
Input points per common		C32, C28: 16 points/common C24: 8 points/common (X0 to X7/1–common, X8 to XF/1–common) (Either the positive or negative of the input power supply can be connected to the common terminal.)
Min. ON voltage/ Min. ON current		For X0, X1, X3, X4: 19.2 V DC/6 mA For X2, X5 to XF: 19.2 V DC/3 mA
Max. OFF voltage/ Max. OFF current		2.4 V DC/1.3 mA
Input impedance		For X0, X1, X3, X4: approx. 3 kΩ For X2, X5 to X7: approx 5.6 kΩ For X8 to XF: approx 6.8 kΩ
Response time	**OFF → ON**	For input X0, X1, X3, X4: 1 ms or less: normal input 5 μs or less: high–speed counter, pulse catch, interrupt input settings For input X2, X5 to X7: 1 ms or less: normal input 100 μs or less: high–speed counter, pulse catch, interrupt input settings For input X8 to XF: 1 ms or less: normal input only
	ON → OFF	Same as above
Operating mode indicator		LED display

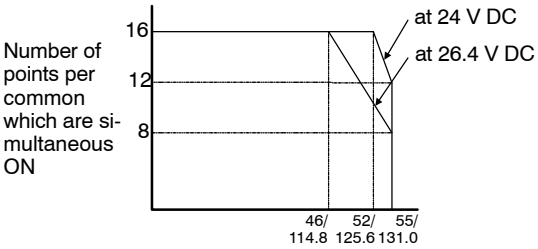
Notes

- **X0 through X7 are inputs for the high-speed counter and have a fast response time. If used as normal inputs, we recommend inserting a timer in the ladder program as chattering and noise may be interpreted as an input signal.**
- **The above specifications apply when the rated input voltage is 24 VDC and the temperature is 25°C/70°F.**

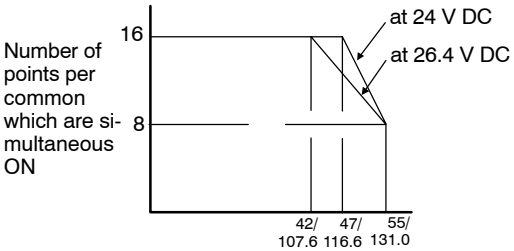
Limitations on the number of input points which are simultaneously ON

Keep the number of input points per common which are simultaneously on within the following range as determined by the temperature.

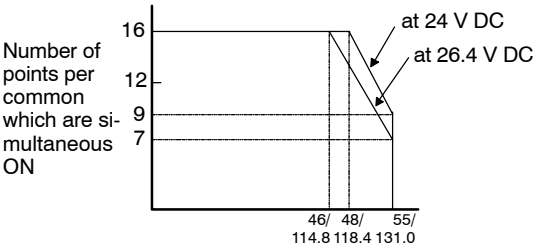
[C32]



[C28]

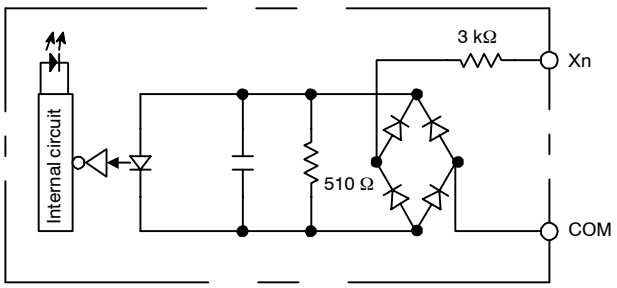


[C24]

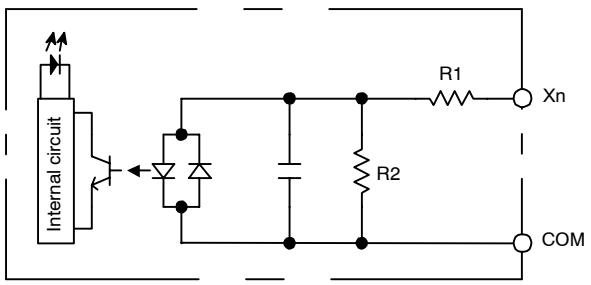


Internal circuit diagram

[X0, X1, X3, X4]



[X2, X5 to XF]



For X2 and X5 to X7, R1: 5.6 kΩ, R2: 1 kΩ
For X8 to XF, R1: 6.8 kΩ, R2: 820 Ω

2.3 Output Specifications

The FPΣ is available as a transistor and as a relay output type. Below you will find the specifications for both types.

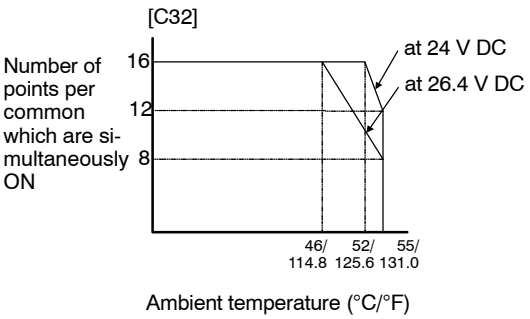
2.3.1 Transistor Output Specifications

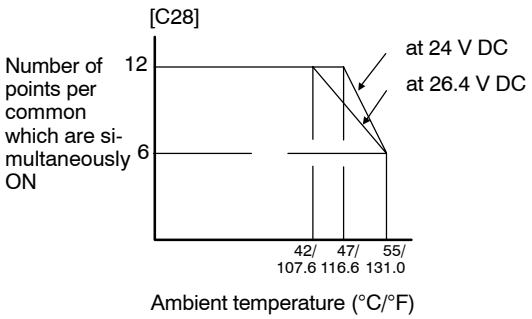
These output specifications apply to the C32 and C28 control units.

Item		Description	
		C32 (NPN)	C28 (PNP)
Insulation method		Optical coupler	
Output type		Open collector	
Rated load voltage		5 to 24 V DC	24 V DC
Operating load voltage range		4.75 to 26.4 V DC	21.6 to 26.4 V DC
Max. load current		For Y0, Y1, Y3, Y4: 0.3 A For Y2, Y5 to YF: 0.1 A	For Y0, Y1, Y3, Y4: 0.5 A For Y2, Y5 to YB: 0.3 A
Max. surge current		For Y0, Y1, Y3, Y4: 0.9 A For Y2, Y5 to YF: 0.5 A	For Y0, Y1, Y3, Y4: 1.5 A For Y2, Y5 to YB: 0.7 A
Output points per common		16 points/common	12 points/common
OFF state leakage current		100 μA or less	
ON state voltage drop		0.5 V or less	
Response time	OFF→ON	For Y0, Y1, Y3, Y4 (at 15 mA or more): 2 μs or less For Y2, from Y5: 0.2 ms or less	
	ON→OFF	For Y0, Y1, Y3, Y4 (at 15 mA or more): 8 μs or less For Y2, from Y5: 0.5 ms or less	
External power supply for driving internal circuit	Voltage	21.6 to 26.4 V DC	
	Current	70 mA or less	
Surge absorber		Zener diode	
Operating mode indicator		LED display	
Phase fault protection		Thermal protection for Y2, from Y5	

Limitations on the number of output points which are simultaneously ON

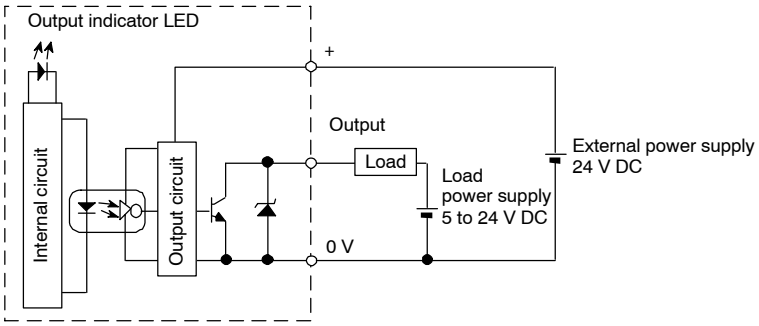
Keep the number of output points per common which are simultaneously on within the following range as determined by the ambient temperature.



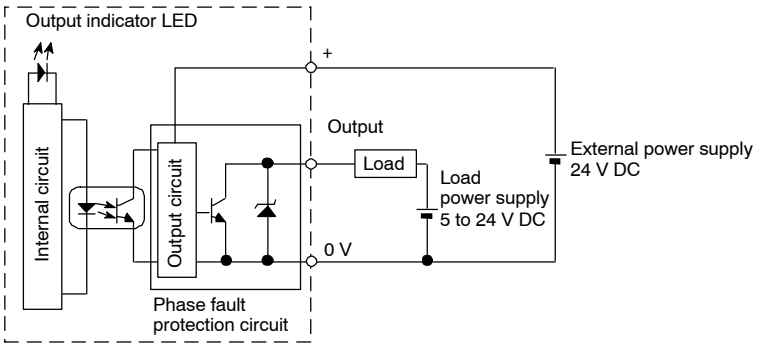


Internal circuit diagram

[Y0, Y1, Y3, Y4]



[Y2, Y5 to YF]



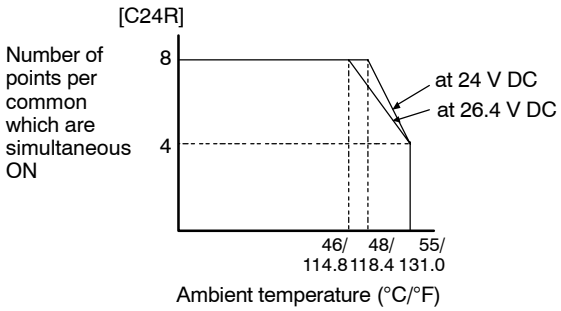
2.3.2 Relay Output Specifications

These output specifications apply to the C24 control unit.

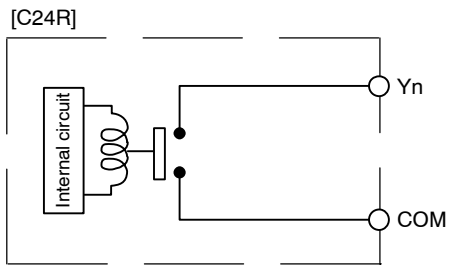
Item		Description
Output type		1a (1 Form A, Normally open)
Rated control capacity		2 A 250 V AC, 2 A 30 V DC (4.5 A per common or later)
Output points per common		8 points/common
Response time	**off → on**	Approx. 10 ms
	on → off	Approx. 8 ms
Mechanical lifetime		Min. 20,000,000 operations
Electrical lifetime		Min. 100,000 operations
Surge absorber		–
Operating mode indicator		LED display

Limitations on the number of output points which are simultaneously ON

Keep the number of output points per common which are simultaneously on within the following range as determined by the ambient temperature.



Internal circuit diagram

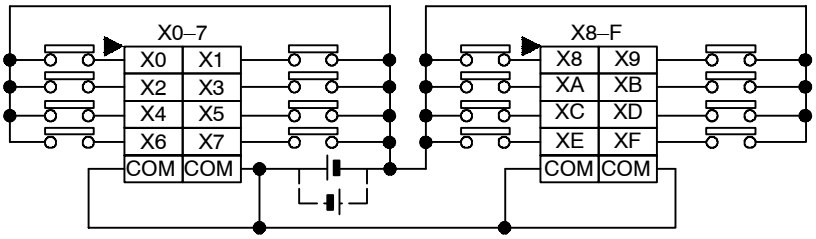


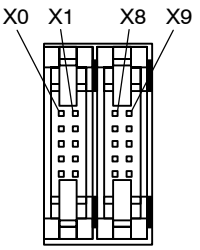
2.4 Terminal Layout Diagrams

Below are the terminal layout diagrams of the C32T/C32T2 and C24R2 control units.

2.4.1 C32T and C32T2 Control Units

Input connector



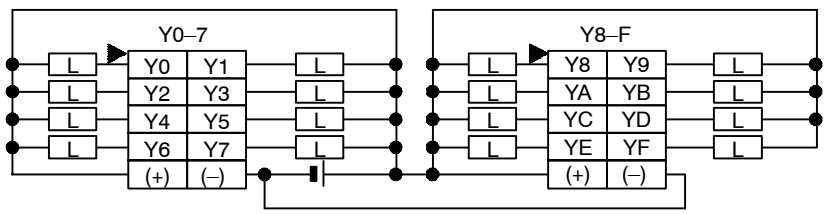


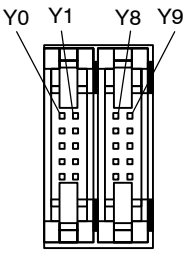
Connector front view

Note

The four COM terminals of the input circuit are connected internally.

Output connector





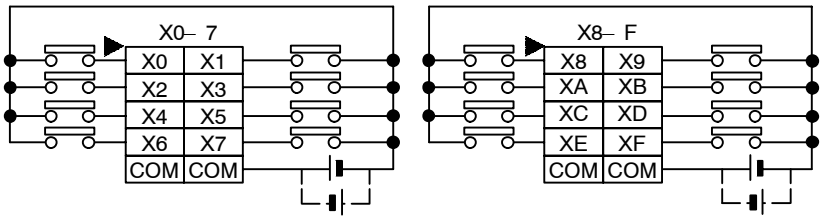
Connector front view

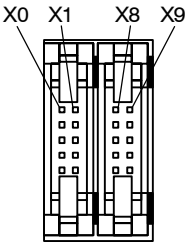
Notes

- **The two (+) terminals of the output circuit are connected internally.**
- **The two (–) terminals of the output circuit are connected internally.**

2.4.2 C28P Control Unit

Input connector

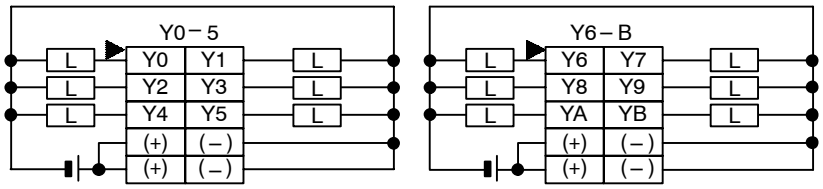


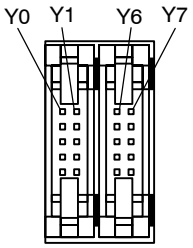


Note

The four COM terminals of the input circuit are connected internally.

Output connector





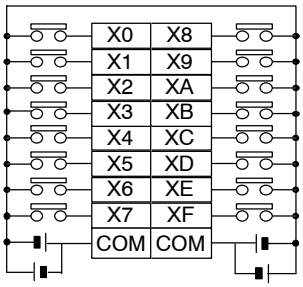
Connector front view

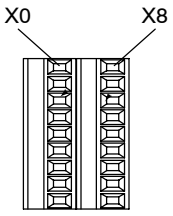
Notes

- **The two (+) terminals of the output circuit are connected internally.**
- **The two (–) terminals of the output circuit are connected internally.**

2.4.3 C24R2 Control Unit

Input connector



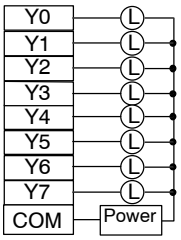


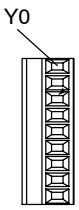
Connector front view

Note

The two COM terminals of the input circuit are not connected internally.

Output connector





Connector front view

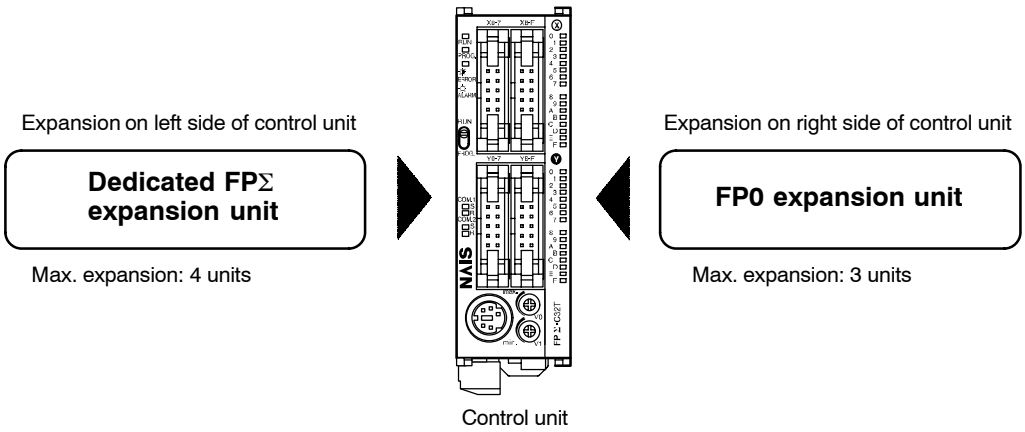
Chapter 3

Expansion

3.1 Types of Expansion Units

Expansion I/O units, power supply units, and intelligent units from the FP0 series as well as dedicated FPΣ expansion and intelligent units can be connected to the control unit.

Expansion units from the FP0 series are connected on the right side of the control unit, just as they are with the FP0. Dedicated expansion units for the FPΣ are connected to the left side of the control unit.


Expansion on left side of control unit
Dedicated FPΣ expansion unit
Max. expansion: 4 units
Expansion on right side of control unit
FP0 expansion unit
Max. expansion: 3 units
Control unit

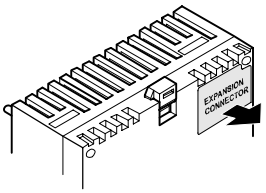
3.2 Adding FP0 Units

The FP0 expansion I/O units or intelligent units are connected to the right side of the control unit.

Because unit expansion is done using the right–side connector for FP0 expansion and the expansion hooks on the side of the unit, no expansion cable is needed.

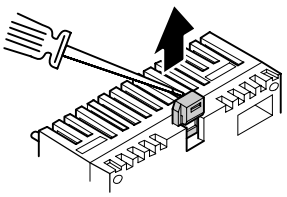
Procedure:

1. **Peel seal on right side of control unit to expose internal expansion connector**

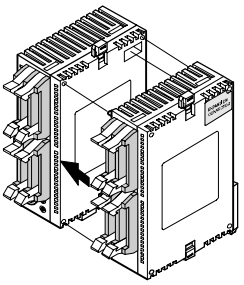


Peel the seal.

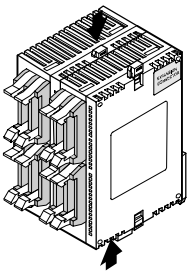
2. **Raise expansion hooks on top and bottom of control unit**



3. **Align pins and holes in all four corners**



4. **Attach expansion unit to control unit**
5. **Press down expansion hooks**



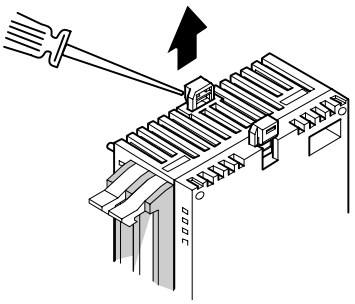
You can now add up to two more units in the same manner.

3.3 Adding FPΣ Expansion Units

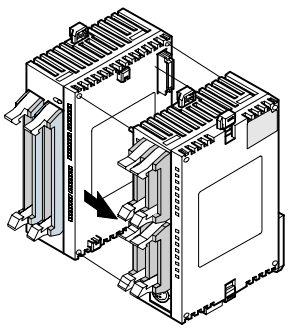
The dedicated expansion and intelligent units for the FPΣ are connected to the left side of the control unit. Because unit expansion is done using the left–side connector for FPΣ expansion and the expansion hooks on the side of the unit, no expansion cable is needed.

Procedure:

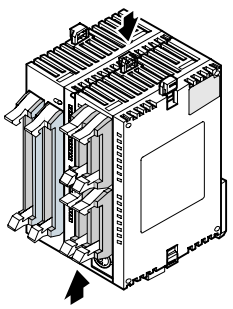
1. **Remove cover on left side of unit so that internal left–side connector for FPΣ expansion is exposed**
2. **Raise expansion hooks on top and bottom of control unit**



3. **Align pins and holes in all four corners**

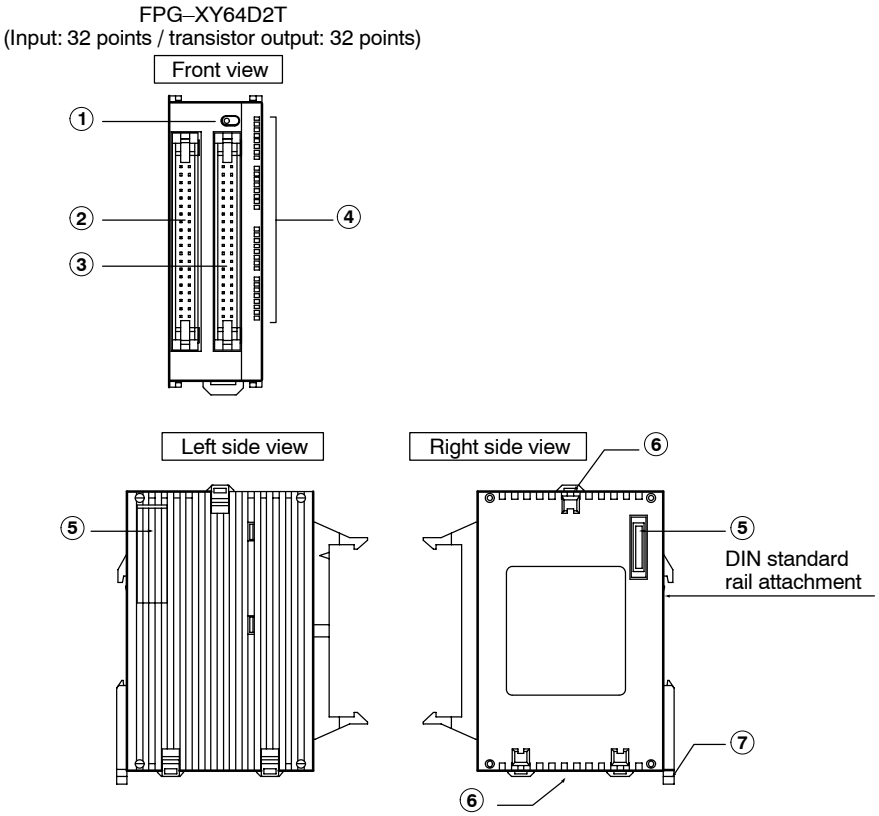


4. **Attach expansion unit to control unit**
5. **Press down expansion hooks**



You can now add up to three more units in the same manner.

3.4 Parts and Functions of FPΣ Expansion Unit



① LED display selection switch

Switches between the LED display of the 32 input points and the LED display of the 32 output points.

② Input connector (40 pins)

③ Output connector (40 pins)

④ Input and output indicator LEDs

⑤ FPΣ expansion connector

Used to connect the unit to the control unit or another expansion unit.

⑥ Expansion hook

Used to secure the expansion unit. The hook is also used for installation on the FP0 flat type mounting plate (part no. AFP0804).

⑦ DIN rail attachment lever

Used for easy attachment to a DIN rail. The lever is also used for installation on the FP0 slim 30 type mounting plate (part no. AFP0811).

3.5 Specifications of FPΣ Expansion Unit

Input specifications

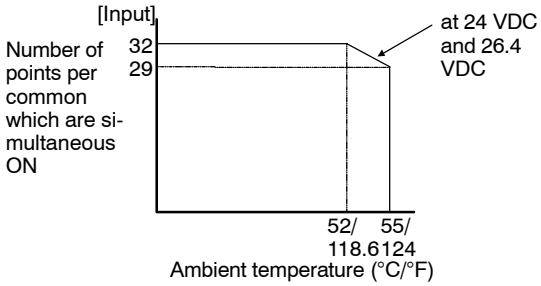
Item		Description
Insulation method		Optical coupler
Rated input voltage		24 V DC
Operating voltage range		21.6 to 26.4 V DC
Rated input current		Approx. 3.5 mA
Input points per common		32 points/common (Either the positive or negative of input power supply can be connected to common terminal.)
Min. ON voltage/Min. ON current		19.2 V DC/3 mA
Max. OFF voltage/Max. OFF current		2.4 V DC/1.3 mA
Input impedance		Approx. 6.8 kΩ
Response time	**OFF → ON**	0.2 ms or less
	ON → OFF	0.3 ms or less
Operating mode indicator		LED display

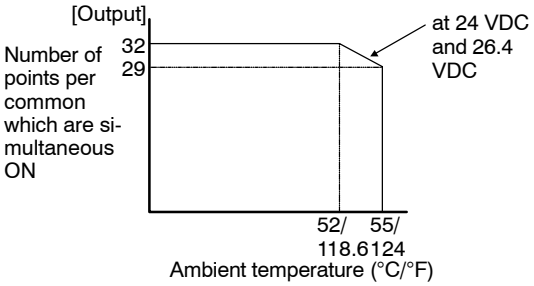
Transistor output specifications

Item		Description
Insulation method		Optical coupler
Output type		Open collector (NPN)
Rated load voltage		5 to 24 V DC
Operating load voltage range		4.75 to 26.4 V DC
Max. load current		0.1 A
Max. surge current		0.5 A
Output points per common		32 points/common
OFF state leakage current		100 μA or less
ON state voltage drop		0.5 V or less
Response time	**OFF → ON**	0.2 ms or less
	ON → OFF	0.5 ms or less
External power supply for driving internal circuit	**Voltage**	21.6 to 26.4 V DC
	Current	15 mA or less
Surge absorber		Zener diode
Operating mode indicator		LED display
Phase fault protection		Thermal protection

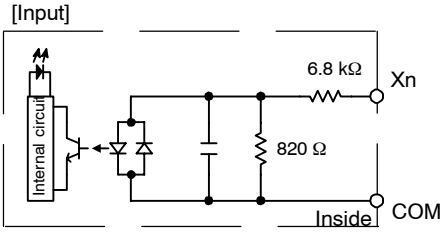
Limitations on the number of points which are simultaneously ON

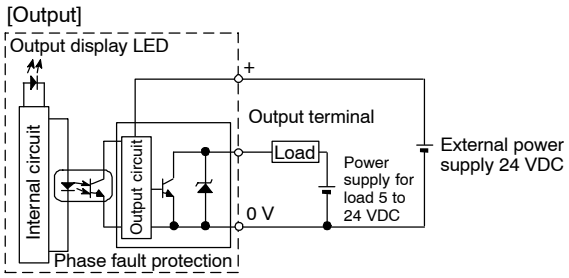
Keep the number of points which are simultaneously on within the following range as determined by the ambient temperature.





Internal circuit diagram



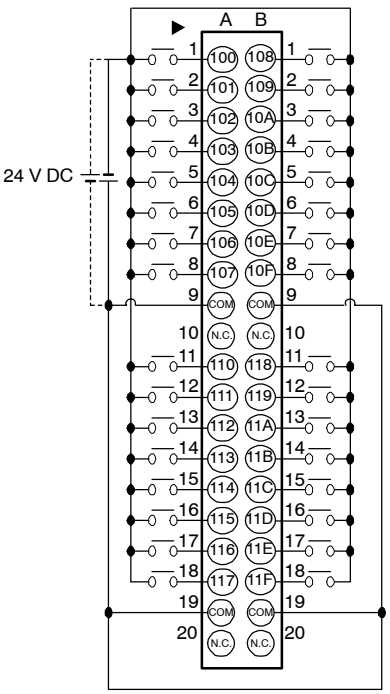


Terminal layout diagram

Note

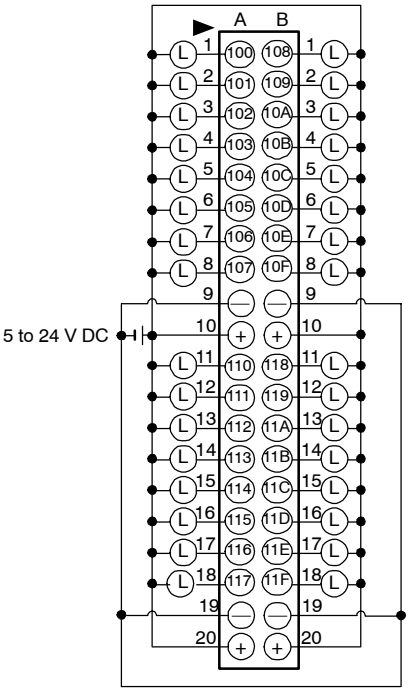
The I/O numbers on the connector refer to the first expansion unit.

Input connector (left)



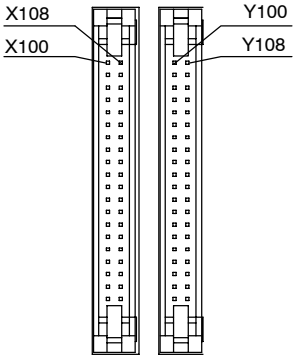
The COM terminals are connected internally with the same connector.

Output connector (right)



Although (+) and (–) terminals are connected internally with the same connector, it is recommended that they also be connected externally.

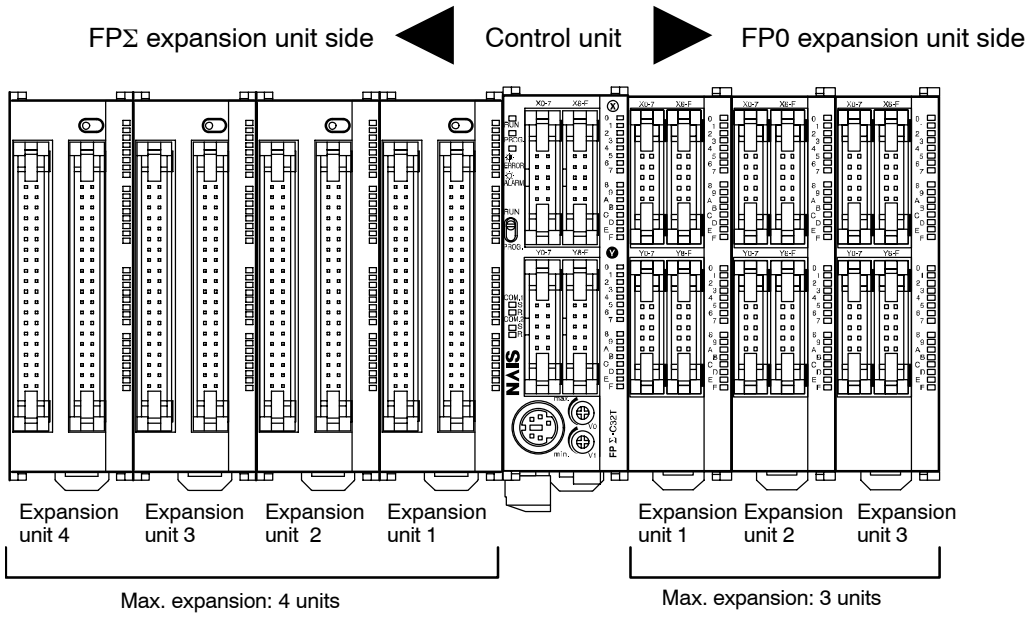
Front view of connector



Chapter 4

I/O Allocation

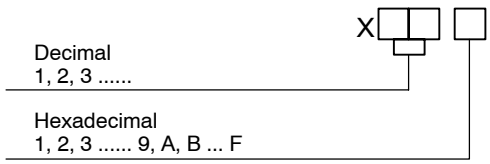
4.1 General



4.1.1 I/O Numbers

Since the input relay (X) and the output relay (Y) are handled in units of 16 points, I/O numbers are expressed as a combination of decimal and hexadecimal numbers as shown below.

Example:



Specifying X and Y numbers

With the FPΣ and the FP0, the same numbers are used for input and output. For example, 20 can be used for both input (X20) and output (Y20).

4.2 I/O Allocation for FPΣ Units

The tables below show the I/O numbers for FPΣ control and expansion units.

4.2.1 FPΣ Control Unit

The I/O allocation of the FPΣ control unit is fixed.

Type of control unit		I/O number
FPG–C32T, FPG–C32TTM FPG–C32T2, FPG–C32T2TM	Input (16 points)	X0 to XF
	Output (16 points)	Y0 to YF
FPG–C28P2	Input (16 points)	X0 to XF
	Output (12 points)	Y0 to YB
FPG–C24R2 FPG–C24RTM	Input (16 points)	X0 to XF
	Output (8 points)	Y0 to Y7

4.2.2 FPΣ Expansion Unit

I/O numbers do not need to be set as I/O allocation is performed automatically when an expansion unit is added.

The I/O allocation of expansion units is determined by the installation location.

Type of expansion unit		Expansion unit 1	Expansion unit 2	Expansion unit 3	Expansion unit 4
FPG–XY64D2T	Input (32 points)	X100 to X11F	X180 to X19F	X260 to X27F	X340 to X35F
	Output (32 points)	Y100 to Y11F	Y180 to Y19F	Y260 to Y27F	Y340 to Y35F

4.2.3 FPΣ Positioning Unit

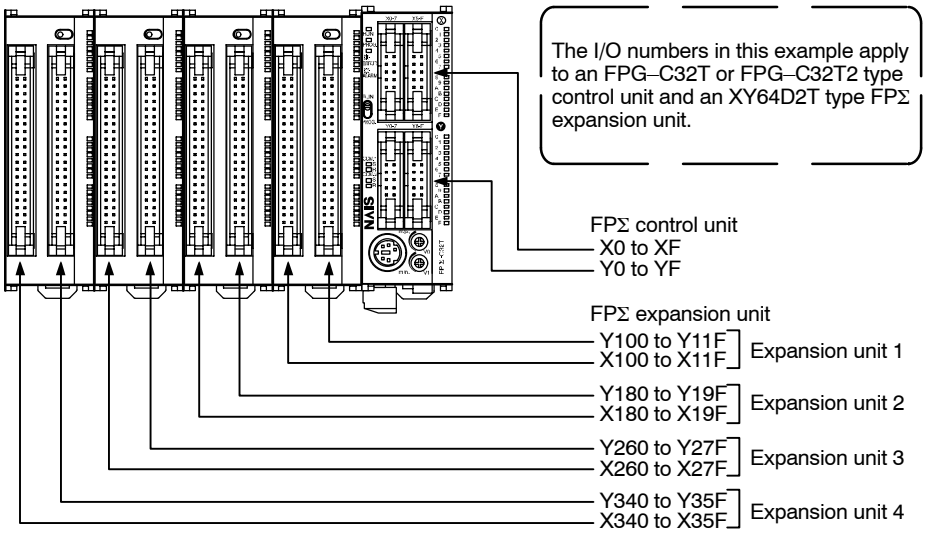
I/O numbers do not need to be set as I/O allocation is performed automatically when an expansion unit is added.

The I/O allocation of positioning units is determined by the installation location.

Type of expansion unit		Expansion unit 1	Expansion unit 2	Expansion unit 3	Expansion unit 4
1–axis type FPG–PP11 FPG–PP12	Input (16 points)	X100 to X10F	X180 to X18F	X260 to X26F	X340 to X34F
	Output (32 points)	Y100 to Y10F	Y180 to Y18F	Y260 to Y26F	Y340 to Y34F
2–axis type FPG–PP21 FPG–PP22	Input (32 points)	X100 to X11F	X180 to X19F	X260 to X27F	X340 to X35F
	Output (32 points)	Y100 to Y11F	Y180 to Y19F	Y260 to Y27F	Y340 to Y35F

Note

The FPΣ expansion unit next to the control unit has the lowest I/O numbers. This is called the expansion unit 1. The next unit is the expansion unit 2 etc.


The I/O numbers in this example apply to an FPG–C32T or FPG–C32T2 type control unit and an XY64D2T type FPΣ expansion unit.
FPΣ control unit
X0 to XF
Y0 to YF
FPΣ expansion unit
Y100 to Y11F
X100 to X11F
Expansion unit 1
Y180 to Y19F
X180 to X19F
Expansion unit 2
Y260 to Y27F
X260 to X27F
Expansion unit 3
Y340 to Y35F
X340 to X35F
Expansion unit 4

4.3 I/O Allocation for FP0 Units

The tables below show the I/O numbers for FP0 expansion, analog I/O, A/D conversion, and I/O link units. I/O numbers do not need to be set as I/O allocation is performed automatically when a unit is added.

4.3.1 FP0 Expansion Unit

The I/O allocation of the expansion unit is determined by the installation location.

Type of expansion unit		Expansion unit 1	Expansion unit 2	Expansion unit 3
FP0–E8X	**Input (8 points)**	X20 to X27	X40 to X47	X60 to X67
FP0–E8R	**Input (4 points)**	X20 to X23	X40 to X43	X60 to X63
	Output (4 points)	Y20 to Y23	Y40 to Y43	Y60 to Y63
FP0–E8YR/E8YT/E8YP	**Output (8 points)**	Y20 to Y27	Y40 to Y47	Y60 to Y67
FP0–E16X	**Input (16 points)**	X20 to X2F	X40 to X4F	X60 to X6F
FP0–E16R/E16T/E16P	**Input (8 points)**	X20 to X27	X40 to X47	X60 to X67
	Output (8 points)	Y20 to Y27	Y40 to Y47	Y60 to Y67
FP0–E16YT/E16YP	**Output (16 points)**	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F
FP0–E32T/E32P	**Input (16 points)**	X20 to X2F	X40 to X4F	X60 to X6F
	Output (16 points)	Y20 to Y2F	Y40 to Y4F	Y60 to Y6F

4.3.2 FP0 Analog I/O Unit

The I/O allocation of the FP0 analog I/O unit FP0–A21 is determined by the installation location.

Unit		Expansion unit 1	Expansion unit 2	Expansion unit 3
Input	**CH0 (16 points)**	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
	CH1 (16 points)	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
Output (16 points)		WY2 (Y20 to Y2F)	WY4 (Y40 to Y4F)	WY6 (Y60 to Y6F)

4.3.3 FP0 A/D Conversion Unit

The I/O allocation of the FP0 A/D conversion unit FP0–A80 is determined by the installation location.

The data for the various channels is converted and loaded with a user program that includes a switching flag to convert the data (see FP0 A/D Converter Unit Technical Manual).

Unit		Expansion unit 1	Expansion unit 2	Expansion unit 3
Input	CH0 (16 points)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
	CH2 (16 points)			
	CH4 (16 points)			
	CH6 (16 points)			
	CH1 (16 points)	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
	CH3 (16 points)			
	CH5 (16 points)			
	CH7 (16 points)			

4.3.4 FP0 Thermocouple Input Unit

The I/O allocation of the FP0 thermocouple input unit FP0–TC4/FP0–TC8 is determined by the installation location.

The data for the various channels is converted and loaded with a user program that includes a switching flag to convert the data.

Unit		Expansion unit 1	Expansion unit 2	Expansion unit 3
Input	CH0 (16 points)	WX2 (X20 to X2F)	WX4 (X40 to X4F)	WX6 (X60 to X6F)
	CH2 (16 points)			
	CH4 (16 points)			
	CH6 (16 points)			
	CH1 (16 points)	WX3 (X30 to X3F)	WX5 (X50 to X5F)	WX7 (X70 to X7F)
	CH3 (16 points)			
	CH5 (16 points)			
	CH7 (16 points)			

4.3.5 FP0 I/O Link Unit

The I/O allocation of the FP0 I/O link unit FP0–IOL is determined by the installation location.

Unit	Expansion unit 1	Expansion unit 2	Expansion unit 3
Input (32 points)	X20 to X3F	X40 to X5F	X60 to X7F
Output (32 points)	Y20 to Y3F	Y40 to Y5F	Y60 to Y7F

Chapter 5

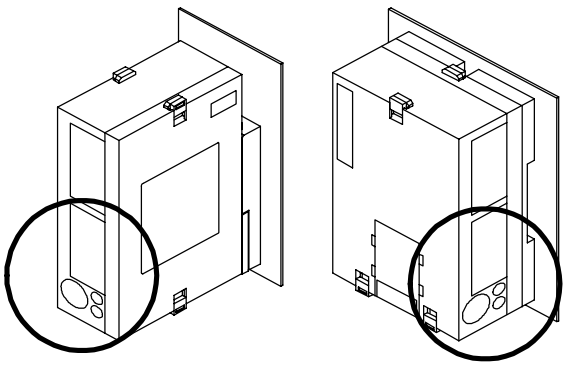
Installation

5.1 Important Notes

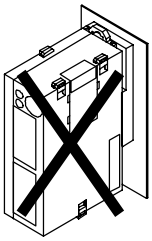
Please read the following notes carefully before installing the FPΣ.

Notes

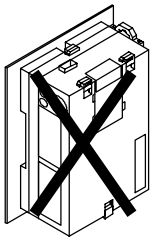
- **Avoid installing the unit in the following locations:**
  - **– Ambient temperatures outside the range of 0°C to 55°C/32°F to 131°F**
  - **– Ambient humidity outside the range of 30% to 85% RH**
  - **– Sudden temperature changes causing condensation**
  - **– Inflammable or corrosive gases**
  - **– Excessive airborne dust, metal particles or salts**
  - **– Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda**
  - **– Excessive vibration or shock**
  - **– Direct sunlight**
  - **– Water or oil in any form including spray or mist**
- **Avoid noise interference from the following sources:**
  - **– Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges.**
  - **– If noise occurs in the power supply line even after the above countermeasures are taken, it is recommended to supply power through an insulation transformer, noise filter, or the like.**
- **Measures regarding heat discharge**
  - **– Always install the unit orientated with the tool port facing outward on the bottom in order to prevent the generation of heat.**



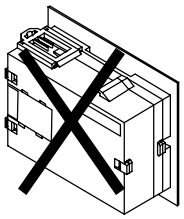
– Do not install the FPΣ control unit as shown below.



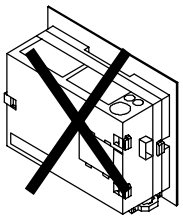
Upside–down



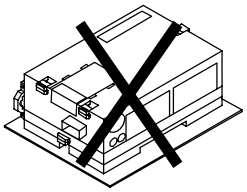
Installation which blocks the air duct



Installations such that the input and output connectors face down



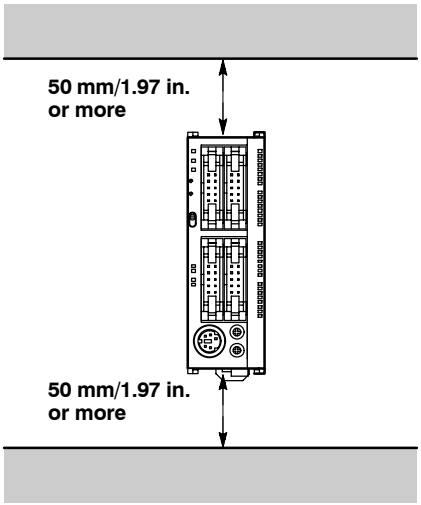
Input and output connectors on top



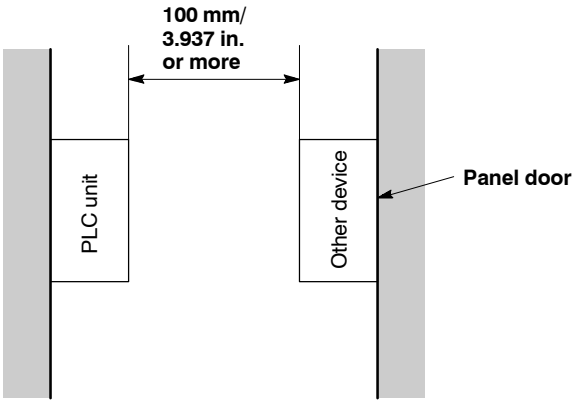
Horizontal installation of the unit

– Do not install the unit above devices which generate heat such as heaters, transformers or large scale resistors.

- **Installation space**
  - **Leave at least 50 mm/1.97 in. of space between the wiring ducts of the unit and other devices to allow heat radiation and unit replacement.**



  - **Maintain a minimum of 100 mm/3.937 in. between devices to avoid adverse affects from noise and heat when installing a device or panel door to the front of the PLC unit.**



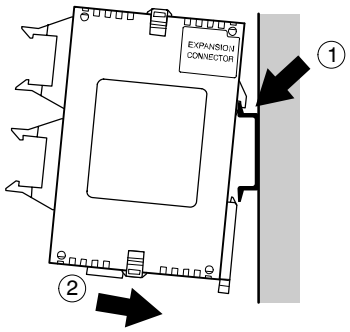
  - **Keep the first 100 mm/3.937 in. from the front surface of the control unit open in order to allow room for programming tool connections and wiring.**

5.2 Attachment to DIN Rails

The FPΣ can easily be attached to DIN rails.

Procedure:

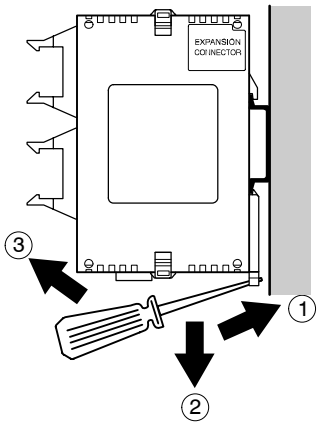
1. **Fit upper hook of unit onto DIN rail**
2. **Without moving upper hook, press on lower hook to fit unit into position**



Removal is very simple, too:

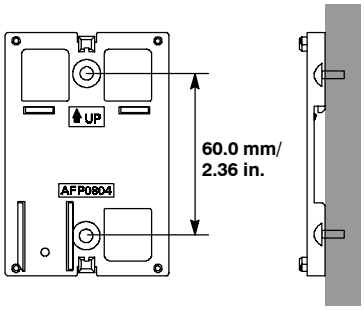
Procedure:

1. **Insert slotted screwdriver into DIN rail attachment lever**
2. **Pull attachment lever downwards**
3. **Lift up unit and remove from rail**



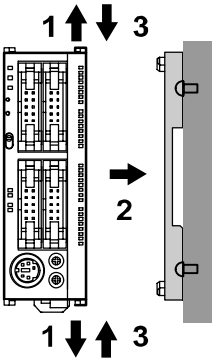
5.3 Installation Using Flat Type Mounting Plate

Use M4 size pan–head screws for the attachment of the flat type mounting plate (AFP0804). The diagram below shows the dimensions of the mounting plate.



Procedure:

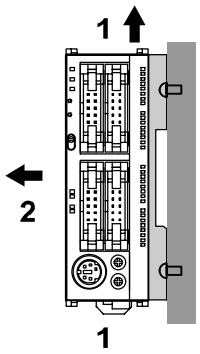
1. **Raise expansion hooks on top and bottom of unit**
2. **Press unit on mounting plate and align hooks with plate**
3. **Press hooks on top and bottom**



Removal from flat type mounting plate

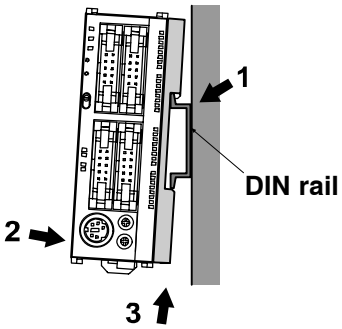
Procedure:

1. **Pull hooks on top and bottom of unit**
2. **Remove unit from mounting plate**



Attachment to DIN rail

A unit with an attached flat type mounting plate can also be installed sideways on a DIN rail.

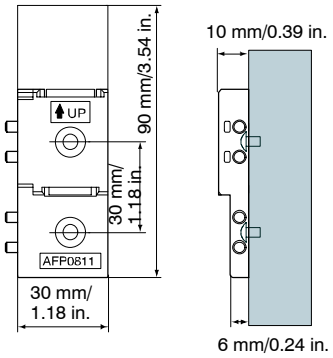


Note

The flat type mounting plate (AFP0804) should only be used with a stand–alone control unit. It should not be used if an FP0 or FPΣ expansion unit is attached to the control unit.

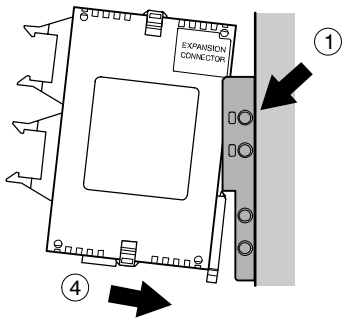
5.4 Installation Using Slim 30 Type Mounting Plate

Use M4 size pan–head screws for attachment of the slim 30 type mounting plate (AFP0811) to the mounting panel. The diagram below shows the dimensions of the mounting plate.



Procedure:

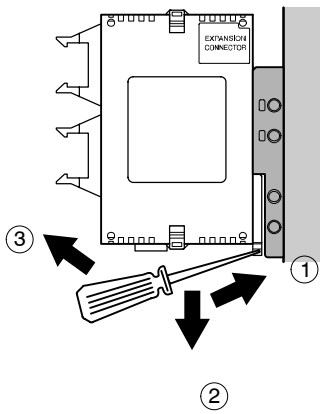
1. **Fit upper hook of unit onto DIN rail**
2. **Without moving upper hook, press on lower hook to fit unit into position**



Removal from Slim 30 Type Mounting Plate

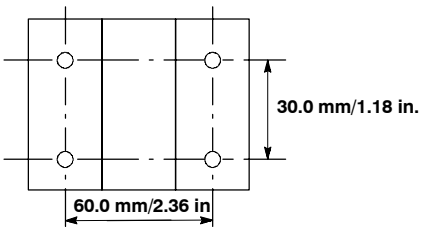
Procedure:

1. **Insert slotted screwdriver into DIN rail attachment lever**
2. **Pull attachment lever downwards**
3. **Lift up unit and remove from rail**



When using an expansion unit, tighten the screws after joining all of the slim 30 type mounting plates to be connected. Tighten all corner screws.

Example: Installation using two expansion units



5.5 Backup Battery

This section covers installation and lifetime of the backup battery as well as the setting of the battery alarm error function.

Notes

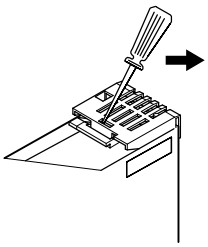
- **If system register no. 4 “Battery error indication” (“Alarm Battery Error” in FPWIN GR) is set to ON, special internal relays R9005 and R9006 will go on if the battery voltage drops, and the ERROR/ALARM LED will flash. The battery remains effective for about a week after the alarm is issued, but in some cases the problem is not detected immediately. The battery should be replaced as soon as possible, without turning off the power supply.**
- **When replacing the battery, connect the new battery within 20 seconds of removing the old one.**

5.5.1 Installation

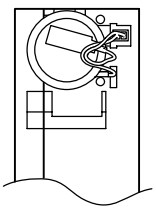
If a backup battery is installed in the FPΣ, clock/calendar functions can be used and data registers or other data can be backed up.

Procedure:

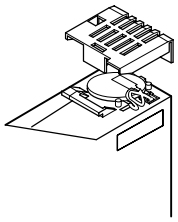
1. **Using a screwdriver or similar tool, open battery cover**



2. **Connect connector, and place battery so that battery terminal fits between the two tabs**



3. **Insert battery cover from above**



5.5.2 Setting System Registers

To use the backup battery for backup functions, system registers 4 (battery error alarm) and 6 to 12 (definition of hold areas) need to be set.

Notes

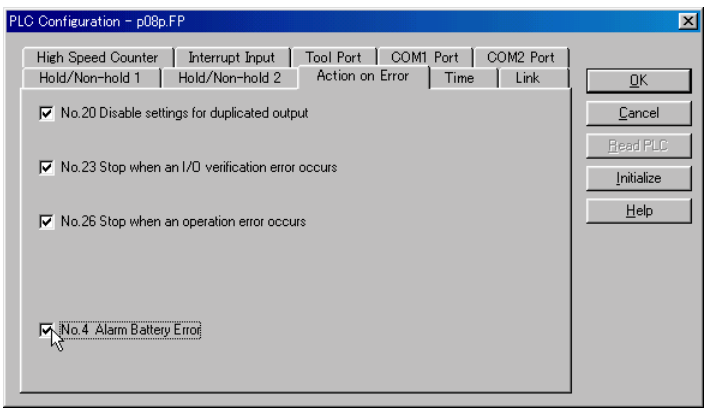
- **Settings for registers 6 to 12 are only enabled when a backup battery is installed.**
- **If no battery is installed, use the initial values. If the settings are changed, whether the values are saved is undefined.**

5.5.2.1 Setting the Battery Error Alarm

In the system register default settings, item no. 4 “Battery error indication” is set to “Disable” (FPWIN GR: “No. 4 Alarm Battery Error” set to “Off”). When using the battery, set system register no. 4 of the control unit so that the battery error alarm is turned on.

Procedure for FPWIN GR:

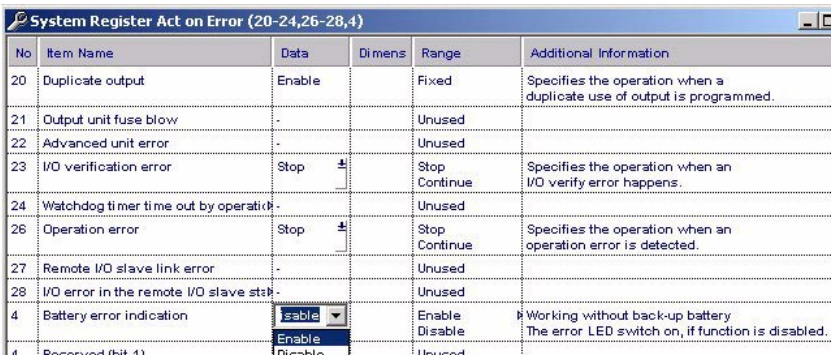
1. **Option –> PLC Configuration**
2. **Click “Action on Error” tab**



3. **Choose“No. 4 Alarm Battery Error”**

Procedure for FPWIN Pro:

1. **Double–click “PLC” in the project navigator**
2. **Double–click “System Register”**
3. **Double–click “Act on Error”**
4. **Choose “Enable” in the list box of item no. 4 “Battery error indication”**


System Register Act on Error (20-24,26-28,4)
No
Item Name
Data
Dimens
Range
Additional Information
20 Duplicate output Enable Fixed Specifies the operation when a duplicate use of output is programmed.
21 Output unit fuse blow - Unused
22 Advanced unit error - Unused
23 I/O verification error Stop Stop Continue Specifies the operation when an I/O verify error happens.
24 Watchdog timer time out by operati - Unused
26 Operation error Stop Stop Continue Specifies the operation when an operation error is detected.
27 Remote I/O slave link error - Unused
28 I/O error in the remote I/O slave st - Unused
4 Battery error indication Enable Enable Disable Working without back-up battery The error LED switch on, if function is disabled.

5.5.2.2 Specifying the Hold Area

In order to use backup functions (e. g. for data registers), settings must be entered for system registers no. 6 to 12.

Procedure for FPWIN GR:

1. **Option –> PLC Configuration**
2. **Choose “Hold/Non–hold 1” or “Hold/Non–hold 2” tab**

Procedure for FPWIN Pro:

1. **Double–click “PLC” in the project navigator**
2. **Double–click “System Register”**
3. **Double–click “Hold On/Off”**

5.5.3 Lifetime

The life of the backup battery will eventually expire, and therefore it is important to replace it with a new battery periodically. A guideline for a replacement interval is given below.

Item	Description
Battery lifetime	220 days or more* (typical lifetime in actual use: approx. 840 days at 25 °C/70 °F) Suggested replacement interval: 1 year *Value when no power at all is supplied

Backup battery

Name	Part no.
Battery for FPΣ	AFPG804

Chapter 6

Wiring

6.1 Safety Instructions

In certain applications, malfunction may occur for the following reasons:

- Power ON timing differences between the PLC system and input/output or motorized devices
- An operation time lag when a momentary power failure occurs
- Abnormality in the PLC, power supply circuit, or other devices

In order to prevent a malfunction that results in a system shutdown, choose the adequate safety measures listed below:

Interlock circuit

When a motor's clockwise/counter-clockwise operation is controlled, provide an interlock circuit that prevents clockwise and counter–clockwise signals from being input into the motor at the same time.

Emergency stop circuit

Add an emergency stop circuit externally to controlled devices in order to prevent a system shutdown or an irreparable accident if a malfunction occurs.

Start–up sequence

The PLC should be operated only after all of the outside devices are energized. To ensure this sequence, the following measures are recommended:

- Turn ON the PLC with the mode selector set to PROG mode, and then switch to RUN mode
- Program the PLC so as to disregard the inputs and outputs until the outside devices are energized

Note

When stopping the operation of the PLC, also have the input/output devices turned off after the PLC has stopped operating.

Grounding

When installing the PLC next to devices that generate high voltages from switching, such as inverters, do not ground them together. Use an exclusive ground for each device.

Momentary power failures

If the duration of the power failure is less than 4 ms, the FPΣ continues to operate. If the power is off for 4 ms or longer, operation changes depending on the combination of units, the power supply voltage, and other factors. (In some cases, operation may be the same as that for a power supply reset.)

Protection of power supply

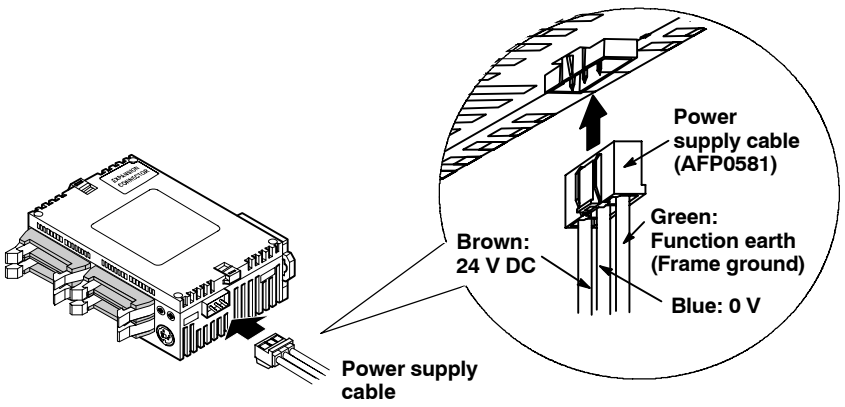
An insulated power supply with an internal protective circuit should be used (FP0–PSA2 or FP–PS24–050). The power supply for the control unit is a non-insulated circuit, so if an incorrect voltage is directly applied, the internal circuit may be damaged or destroyed. If using a power supply without a protective circuit, power should be supplied through a protective element such as a fuse.

Protection of output sections

If current exceeding the rated control capacity is being supplied in the form of a motor lock current or a coil shorting in an electromagnetic device, a protective element such as a fuse should be attached externally.

6.2 Wiring of Power Supply

Use the power supply cable (part no. AFP0581) that comes with the unit to connect the power supply.

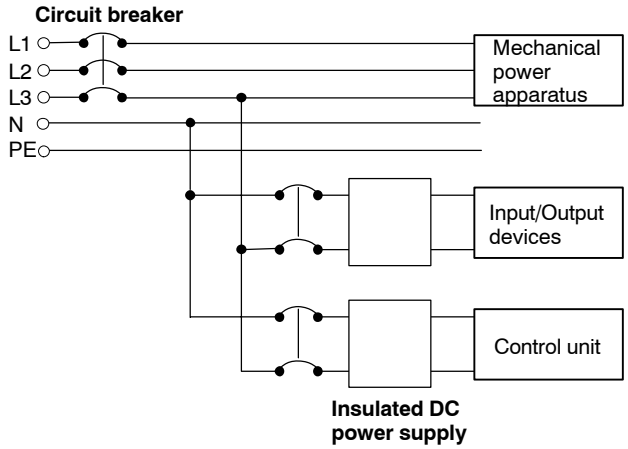


Rated voltage	24 V DC
Operating voltage range	21.6 to 26.4 V DC

Notes

- **To minimize adverse effects from noise, twist the brown and blue wires of the power supply cable.**
- **To protect the system against incorrect voltage from the power supply line, use an insulated power supply with an internal protective circuit.**
- **The regulator on the unit is a non-insulated type.**
- **If using a power supply device without an internal protective circuit, always make sure power is supplied to the unit through a protective element such as a fuse.**

- **Isolate the wiring systems to the control unit, input/output devices, and mechanical power apparatus.**

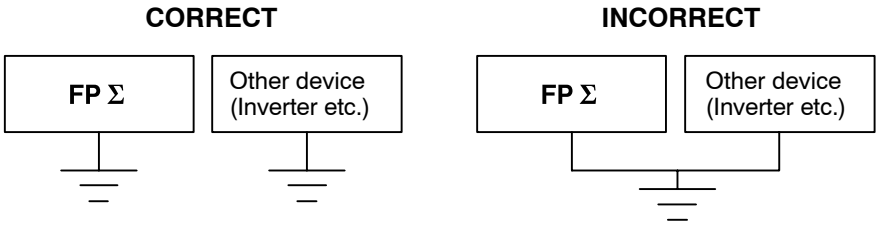


- **The power supply sequence should be set up so that power to the control unit is turned off before the input/output power supplies.**
- **If the input/output power supplies are turned off before the power to the control unit, the control unit will detect the input fluctuations and may begin an unexpected operation.**
- **Be sure to supply power to a control unit and an expansion unit from the same power supply, and turn the power on and off simultaneously for both.**

6.3 Grounding

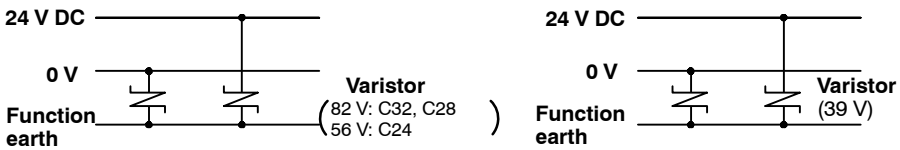
Under normal conditions, the inherent noise resistance is sufficient. However, in situations of excess noise, ground the unit to increase noise suppression.

For grounding purposes, use wires with a **minimum of 2 mm^2**. The grounding connection should have a resistance of **less than 100 Ω**.



Notes

- **The point of grounding should be as close to the PLC unit as possible. The ground wire should be as short as possible.**
- **If two devices share a single ground point, it may produce an adverse effect. Always use an exclusive ground for each device.**
- **Depending on the surroundings in which the equipment is used, grounding may cause problems.**
  Example:
  Since the power supply line (24 V DC and 0 V terminal) of the FPΣ power supply connector is connected to the function earth through a varistor, the varistor may be shorted out if there is an irregular potential between the power supply line and function earth.



- **Changes to Power Cable Specifications**
  In order to improve EMC performance when using an FPΣ intelligent expansion unit, we have changed the specification to a ferrite–core cable (part number AFPG805). When using an FPΣ intelligent expansion unit, be sure to use a ferrite–core cable (part number AFPG805).

6.4 Input Wiring

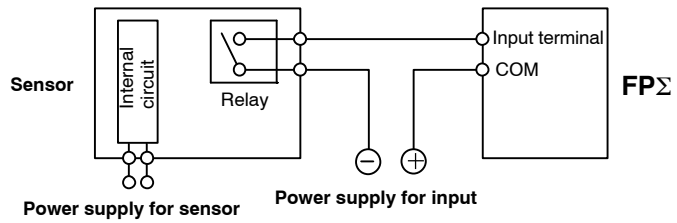
For connecting input devices see the diagrams and recommendations given below.

Notes

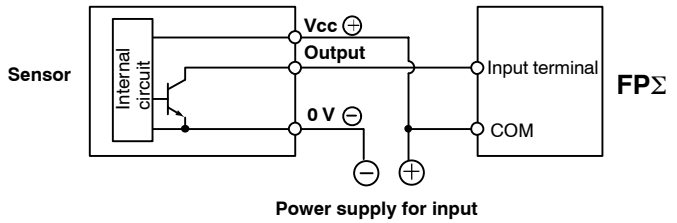
- **Be sure to select the thickness (dia.) of the input and output wires while taking into consideration the required current capacity.**
- **Arrange the wiring so that the input and output wiring are separated and so that these wirings are separated from the power wiring as much as possible. Do not route them through the same duct or wrap them up together.**
- **Separate the input/output wires from the power and high voltage wires by at least 100 mm/3.937 in.**

6.4.1 Photoelectric and Proximity Sensors

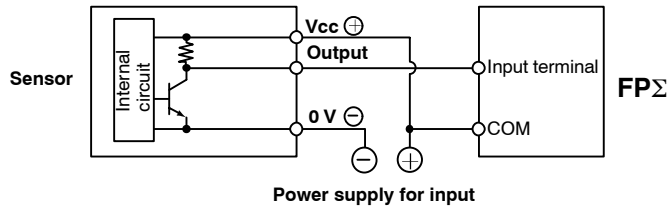
Relay output type



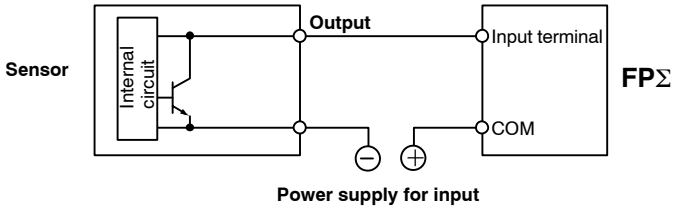
NPN open collector output type



Voltage output (universal output) type

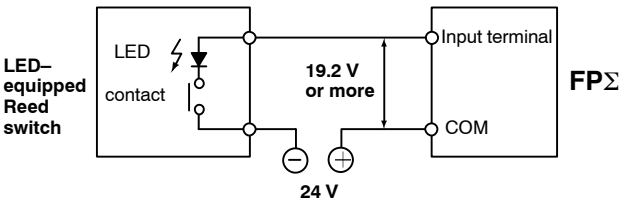


Two-wire output type



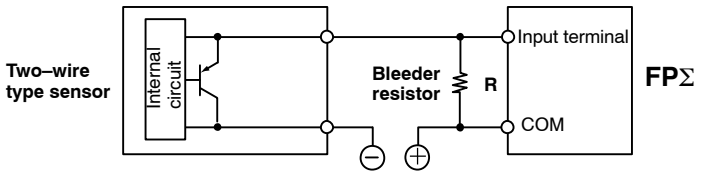
6.4.2 LED–Equipped Reed Switch

When an LED is connected in series to an input contact such as an LED-equipped Reed switch, make sure that the ON voltage applied to the PLC input terminal is greater than 19.2 V DC. In particular, take care when connecting a number of switches in series.



6.4.3 Two–Wire Type Sensor

If the input of the PLC does not turn off because of leakage current from the two-wire type sensor (photoelectric sensor or proximity sensor), the use of a bleeder resistor is recommended, as shown below.



The OFF voltage of the input is 2.4 V, therefore, select the value of bleeder resistor R so that the voltage between the COM terminal and the input terminal will be less than 2.4 V.

With an input impedance of 5.6 kΩ and the sensor's leakage current I [mA],

the resistance R of the bleeder resistor should be: $R \leqq \frac{2.4 \times 5.6}{5.6 \times I - 2.4}$ [kΩ]

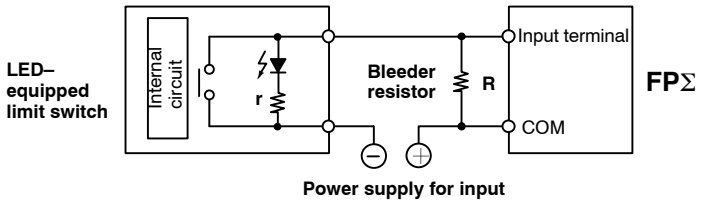
The input impedance varies depending on the input terminal number.

The wattage W of the resistor is: $W = \frac{(\text{Power supply voltage})^2}{R}$ [W]

In the actual selection, use a value that is 3 to 5 times the value of W.

6.4.4 LED–Equipped Limit Switch

If the input of the PLC does not turn off because of the leakage current from the LED-equipped limit switch, the use of a bleeder resistor is recommended, as shown below.



r: Internal resistor of limit switch [kΩ]

The OFF voltage of the input is 2.4 V, therefore when the power supply voltage is 24 V, select the bleeder resistor R so that

the current will be greater than $I = \frac{24 - 2.4}{R}$ [A]

With an input impedance of 5.6kΩ, the resistance R of the bleeder resistor should be:

$$R \leqq \frac{2.4 \times 5.6}{5.6 \times I - 2.4} \text{ [k}\Omega\text{]}$$

The input impedance varies depending on the input terminal number.

The wattage W of the resistor is: $W = \frac{(\text{Power supply voltage})^2}{R}$ [W]

In the actual selection, use a value that is 3 to 5 times the value of W.

6.5 Output Wiring

Protect the outputs as described below.

Notes

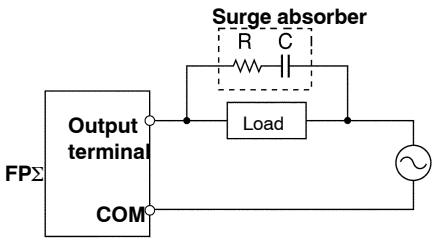
- **To prevent the output circuit from being damaged by a short–circuit or other electrical problems on the output side, a transistor with short–circuit protection is provided.**
- **Be sure to select the thickness (dia.) of the input and output wires while taking into consideration the required current capacity.**
- **Arrange the wiring so that the input and output wiring are separated and so that these wirings are separated from the power wiring as much as possible. Do not route them through the same duct or wrap them up together.**
- **Separate the input/output wires from the power and high voltage wires by at least 100 mm/3.937 in.**

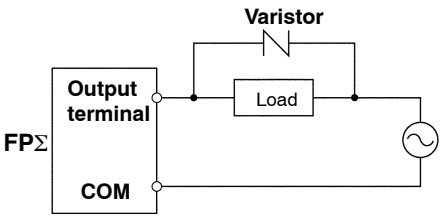
6.5.1 Inductive Loads

With an inductive load, a protective circuit should be installed in parallel with the load.

When switching DC inductive loads with the relay output type, be sure to connect a diode across the ends of the load.

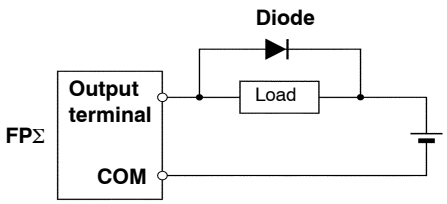
When using an AC inductive load





Example of surge absorber: R: 50 Ω, C: 0.47 μF

When using a DC inductive load

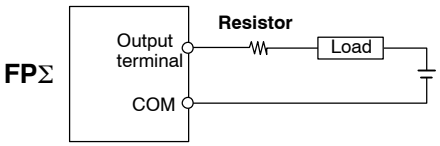


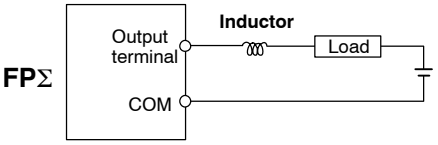
Diode:

Reverse voltage (V_R): 3 times the load voltage
Average rectified forward current (I_0): load current or more

6.5.2 Capacitive Loads

When connecting loads with large in-rush currents, connect a protection circuit as shown below to minimize their effect.



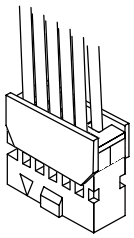


6.6 Wiring the MIL Connector

The following housings, semi-covers and pressure welders are supplied with the FPΣ control unit. Use the wires indicated below. Also use a pressure connection tool for connecting the wires.

Supplied connector (AFP0807)

Type and Product No.	
Housing	10–pin type only
Semi–cover	AXW61001
Welder (contact)	AXW7221

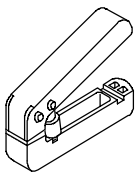


Suitable wires

Size	Conductor cross–sectional area	Insulation thickness
AWG#22	0.3 mm^2	dia. 1.5 to dia. 1.1
AWG#24	0.2 mm^2	

Pressure connection tool

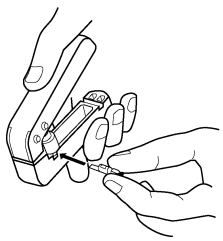
Product No.	AXY52000



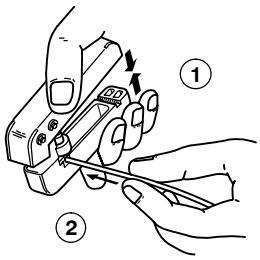
The wire end can be directly crimped without removing the wire's insulation, saving labor:

Procedure:

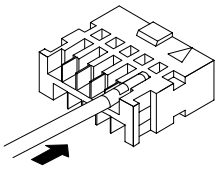
1. **Break off contact from carrier**
2. **Insert wire into pressure connection tool**



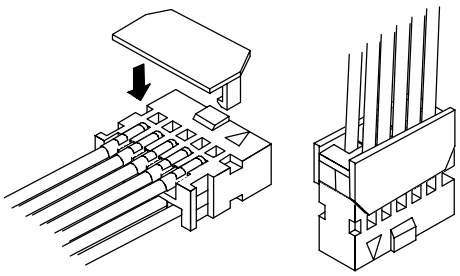
3. **Insert wire without removing its insulation until it stops**



4. **Lightly grip tool**
5. **Insert press-fitted wire into connector housing**

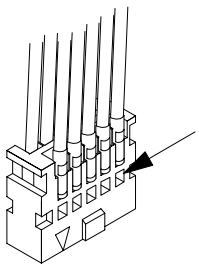


6. **When all wires have been inserted, fit semi-cover into place**



Tip

If there is a wiring mistake or the cable is incorrectly pressure-connected, the contact puller pin provided with the fitting can be used to remove the contact.



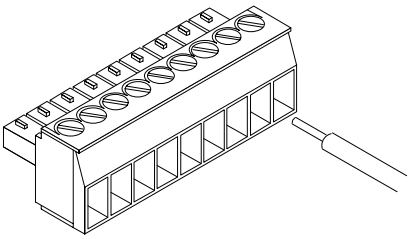
Press the housing against the pressure connection tool so that the contact puller pin comes in contact with this section.

Note

- **If using a MIL connector for flat cables, specify the product no. AXM110915.**

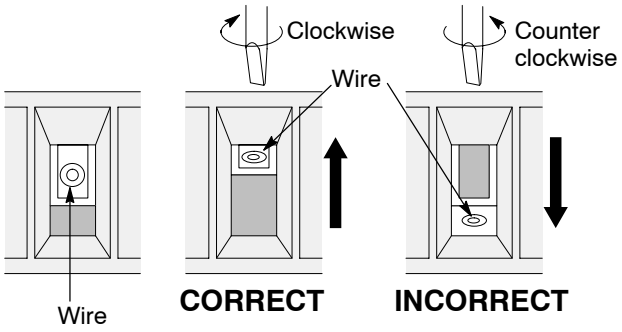
6.7 Wiring the Terminal Block

Screw-type terminal blocks are being used. The suitable wires are given below.



Notes

- **When removing the wire's insulation, be careful not to scratch the core wire.**
- **Do not twist the wires to connect them.**
- **Do not solder the wires to connect them. The solder may break due to vibration.**
- **After wiring, make sure stress is not applied to the wire.**
- **If the socket in the terminal block closes upon counter-clockwise rotation, the connection is wrong. Disconnect the wire, check the terminal hole, and then re-connect the wire.**



Terminal block

Item	Description
Number of pin	9 pins
Manufacturer	Phoenix Contact Co.
Model	MC1,5/9-ST-3,5
Product number	1840434

Suitable wires

Size	Nominal cross–sectional area
AWG #22	0.3 mm^2
AWG #24 to 16	0.2 to 1.25 mm^2

Pole terminals with compatible insulation sleeve

If a pole terminal is being used, the following models can be ordered from Phoenix Contact.

Manufacturer	Cross-sectional area (mm^2)	Size	Part no.
Phoenix Contact	0.25	AWG #24	AI 0,25–6YE
	0.50	AWG #20	AI 0,5–6WH
	0.75	AWG #18	AI 0,75–6GY
	1.00	AWG #18	AI 1–6RD
	0.5 x 2	AWG #20 (for 2 pcs.)	AI–TWIN 2 x 0.5–8WH

Pressure welding tool for pole terminals

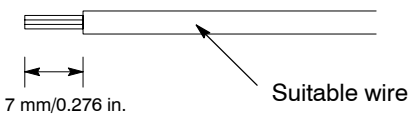
Manufacturer	Phoenix Contact Co.
Part no.	CRIMPFOX UD6
Product number	12 04 43 6

When tightening the terminals of the terminal block, use a screwdriver (Phoenix Contact, product no. 1205037) with a blade size of 0.4 × 2.5. The tightening torque should be 0.22 to 0.25 Nm or less.

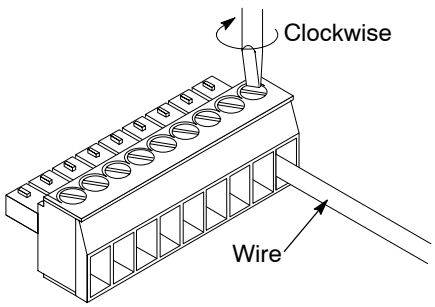
Wiring method

Procedure:

1. **Remove part of wire insulation**



2. **Insert wire into terminal block until it contacts back of socket**
3. **Tighten screw clockwise to fix wire in place**



Chapter 7

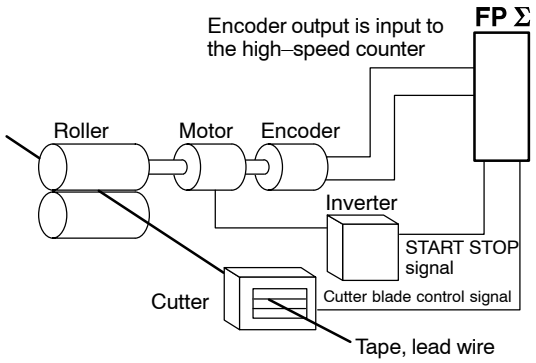
High–Speed Counter and Pulse Output

7.1 Overview

The built–in high–speed counter offers three functions: high–speed counting, pulse output, and PWM (pulse–width modulation) output.

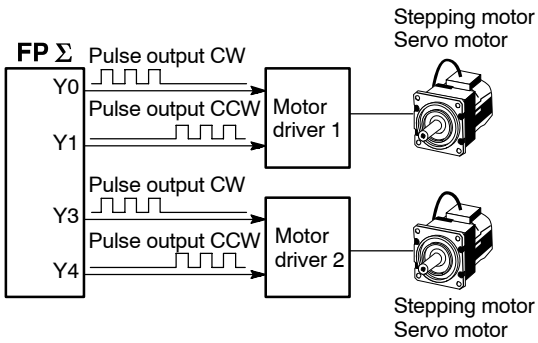
High–Speed Counter Function

The high–speed counter function counts external inputs such as those from sensors or encoders. When the count reaches the target value, this function turns the desired output on or off.



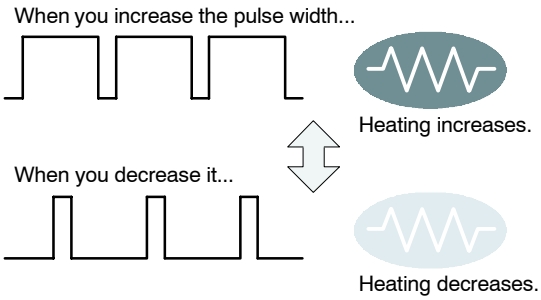
Pulse Output Function

Combined with a commercially available motor driver, this function can be used for positioning control. With an exclusive FP Σ instruction, you can perform trapezoidal control, home return, and JOG operation.



PWM Output Function

By using an exclusive FPΣ instruction, a pulse output of the desired duty ratio is possible with the PWM output function.

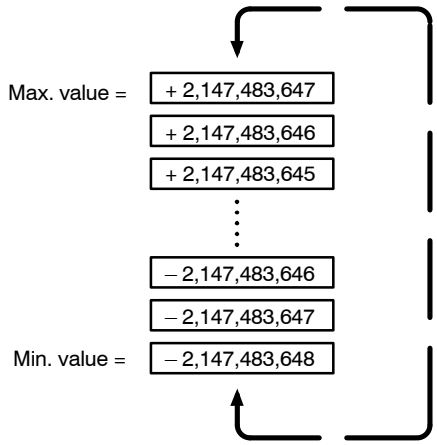


Performance

There are four channels for the built–in high–speed counter. The channel number allocated for the high–speed counter will change depending on the function being used.

The counting range of the built–in high–speed counter is –2,147,483,648 to 2,147,483,647 (coded 32–bit binary).

The high–speed counter is a ring counter. Consequently, if the counted value exceeds the maximum value, it returns to the minimum value. Similarly, if the counted value drops below the minimum value, it goes back to the maximum value and continues counting from there.



Note

When the linear interpolation instruction F175 or the circular interpolation instruction F176 is used, the value for the target value or the amount of travel should be set so that it is within the range of –8,388,608 to +8,388,607 (24–bit binary, with sign). The F175 and F176 instructions can only be used with transistor output type control unit version 2 or higher.

7.2 Function Specifications and Restrictions

This section contains the specifications and restrictions of the functions using the high–speed counter.

7.2.1 Specifications

High–speed counter function

Input/output contact number being used			High–speed counter channel no.	Memory area being used			Performance specifications		Related instructions
On/off output	Count input mode	Input contact number (see note 1)		Control flag	Elapsed value area	Target value area	Min. input pulse width (see note 2)	Max. counting speed	
Specify desired output from Y0 to Y7 in instruction	Incremental, Decremental	X0 (X2)	CH0	R903A	DT90044 to DT90045	DT90046 to DT90047	10 μs	· Using 1 channel: max. 50 kHz (× 1 channel)	F0 (MV), F1 (DMV), F166 (HC1S), F167 (HC1R)
		X1 (X2)	CH1	R903B	DT90048 to DT90049	DT90050 to DT90051		· Using 2 channels: max. 30 kHz (× 2 channels)	
		X3 (X5)	CH2	R903C	DT90200 to DT90201	DT90202 to DT90203		· Using 3 channels: max. 20 kHz (× 3 channels)	
		X4 (X5)	CH3	R903D	DT90204 to DT90205	DT90206 to DT90207		· Using 4 channels: max. 20 kHz (× 4 channels)	
	Two–phase, Incremental/ decremental control	X0 X1 (X2)	CH0	R903A	DT90044 to DT90045	DT90046 to DT90047	25 μs	· Using 1 channel: max. 20 kHz (× 1 channel)	
		X3 X4 (X5)	CH2	R903C	DT90200 to DT90201	DT90202 to DT90203		· Using 2 channels: max. 15 kHz (× 2 channels)	

Notes

1) The value in parentheses is the reset input. Reset input X2 can be set to either CH0 or CH1. Reset input X5 can be set to either CH2 or CH3.

2) For information on the minimum input pulse width, see page 7-10.

Pulse output function

High–speed counter channel no.	Input/output contact number used					Memory area used			Maximum output frequency	Related instructions
	CW or pulse output	CCW or direction output	Deviation counter clear output	Home input	Near home input	Control flag	Elapsed value area	Target value area		
CH0	Y0	Y1	Y2	X2	DT90052 <bit4>	R903A	DT90044 to DT90045	DT90046 to DT90047	· Using 1 channel: max. 100 kHz (× 1 channel) · Using 2 channels: max. 60 kHz (× 2 channels) · Using linear interpolation: max. 100 kHz · Using circular interpolation: max. 20 kHz	**F0 (MV), F1 (DMV), F171 (SPDH), F172 (PLSH), F174 (SPOH) F175 (SPSH) F176 (SPCH)**
CH2	Y3	Y4	Y5	X5	DT90052 <bit4>	R903C	DT90200 to DT90201	DT90202 to DT90203		

Notes

- **The pulse output function is only available with the transistor output type.**
- **Linear and circular interpolation control is only available with transistor output type control unit version 2 or higher.**

PWM output function

High–speed counter channel no.	Output contact number used	Memory area used	Output frequency (duty)	Related instructions
		Control flag		
CH0	**Y0**	R903A	· If resolution = 1000, 1.5 Hz to 12.5 kHz (0.0 to 99.9 %)	**F0 (MV), F1 (DMV), F173 (PWMH)**
CH2	**Y3**	R903C	· If resolution = 100, 15.6 kHz to 41.7 kHz (0 to 99 %)	

Note

The PWM output function is only available with the transistor output type.

7.2.2 Restrictions

Restrictions on channels

The same channel cannot be used by more than one function.

Function	Channel	High–speed counter function					
		Incremental input, decremental input				Two–phase input, incremental/decremental input, incremental/decremental control input	
		CH0	CH1	CH2	CH3	CH0	CH2
Pulse output function	CH0	N/A	A	A	A	N/A	A
	CH2	A	A	N/A	A	A	N/A

A: Available N/A: Not Available

Restrictions on I/O allocations

The inputs and outputs allocated to the various functions listed in the tables in the previous section (see page 7-4) cannot be allocated to more than one function.

Except for the examples noted below, inputs and outputs that have been allocated to the various functions cannot be used as normal inputs and outputs.

Example 1:

If no reset input is used in the high–speed counter function, X2 and X5 can be used as normal inputs.

Example 2:

If no output is used to clear the deviation counter in the pulse output function, Y2 and Y5 can be used as normal outputs.

Restrictions on the execution of instructions

When using the pulse output instructions **F171, F172, F174** and **F175,** specify the initial frequency to 30 kHz or less. Otherwise the first pulse may be lost.

If an instruction related to the high–speed counter (**F166** to **F176**) is executed, the control flag (special internal relay: R903A to R903D) corresponding to the channel used turns on.

Please be aware that the control flag “in progress” may change while a scan is being carried out. To prevent multiple read access to this special internal relay, you should generate a copy of it at the beginning of the program.

When the control flag for a channel turns on, another instruction using that same channel cannot be executed.

Executing circular interpolation control instruction F176 sets the circular interpolation in progress flag (special internal relay: R904E), and that state is maintained until the target value is achieved. During this time, other pulse output instructions (F171 to F176) cannot be executed.

Restrictions on maximum counting speed/pulse output frequency (1)

The maximum frequency when using the high–speed counter and pulse output function is determined by the combination, as shown in the table below.

Channel number being used			Max. frequency		
Pulse output	High–speed counter		Pulse output	High–speed counter	
	Incremental, Decremental	Two–phase, Incremental/decremental, Incremental/decremental control		Incremental, Decremental	Two–phase, Incremental/decremental, Incremental/decremental control
–	1	–	–	50	–
–	1	1	–	20	15
–	–	1	–	–	20
–	2	–	–	30	–
–	2	1	–	20	15
–	–	2	–	–	15
–	3	–	–	20	–
–	4	–	–	20	–
1	–	–	100	–	–
1	1	–	60	30	–
1	2	–	45	20	–
1	3	–	30	20	–
1	–	1	45	–	15
2 *2	–	–	60 *1	–	–
2 *2	1	–	45	20	–
2 *2	2	–	30	20	–

*1. If two channels are not executed simultaneously, each axis may be used up to 100 kHz.

*2. See the table below for maximum counting speed/pulse output frequency when linear/circular interpolation is used.

Restrictions on maximum counting speed/pulse output frequency (2) – When using interpolation function

The maximum frequency when using linear or circular interpolation is shown in the table below.

Channel number being used			Max. frequency		
Pulse output	High–speed counter		Pulse output	High–speed counter	
	Incremental, Decremental	Two–phase, Incremental/decremental, Incremental/decremental control		Incremental, Decremental	Two–phase, Incremental/decremental, Incremental/decremental control
Linear interpolation	–	–	100 *1	–	–
	–	–	80	–	–
	1	–	60	20	–
	2	–	45	20	–
Circular interpolation	–	–	20	–	–
	1	–	20	20	–
	2	–	20	20	–

*1. These are the values when PC link and fixed–interval interrupt functions are not used.

7.2.3 Booting Time

The booting time is the time span from the execution of the instruction to the actual pulse output.

Type of instruction	Booting time
Pulse output instruction F171 (SPDH) **Trapezoidal control/home return**	If CW/CCW is set : approx.200μs (with 30 steps) : approx.400μs (with 60 steps) If pulse/direction is set : approx.500μs (with 30 steps) (see note) : approx.700μs (with 60 steps) (see note)
Pulse output instruction F172 (PLSH) **JOG operation**	If CW/CCW is set: approx. 20 μs If pulse/direction is set: approx. 320 μs (see note)
Pulse output instruction F174 (SP0H) **Data table control**	If CW/CCW is set: approx. 30 μs If pulse/direction is set: approx. 330 μs (see note)
PWM output instruction F173 (PWMH)	Approx. 30 μs

Note

If pulse/direction is set, a waiting time (approx. 300 μs) is included from the time that the direction output goes on until the pulse output instruction can be executed.

7.3 High–Speed Counter Function

The high–speed counter function counts the input signals, and when the count reaches the target value, turns on and off the desired output.

To turn on an output when the target value is matched, use the target value match ON instruction **F166 (HC1S)**. To turn off an output, use the target value match OFF instruction **F167 (HC1R)**.

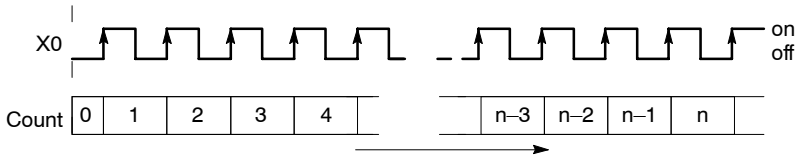
Preset the output to be turned on and off with the **SET**/**RET** instruction.

Setting the system registers

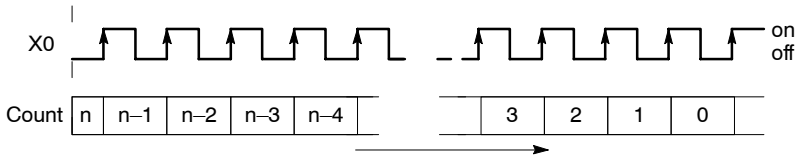
In order to use the high–speed counter function, it is necessary to set system register nos. 400 and 401.

7.3.1 Types of Input Modes

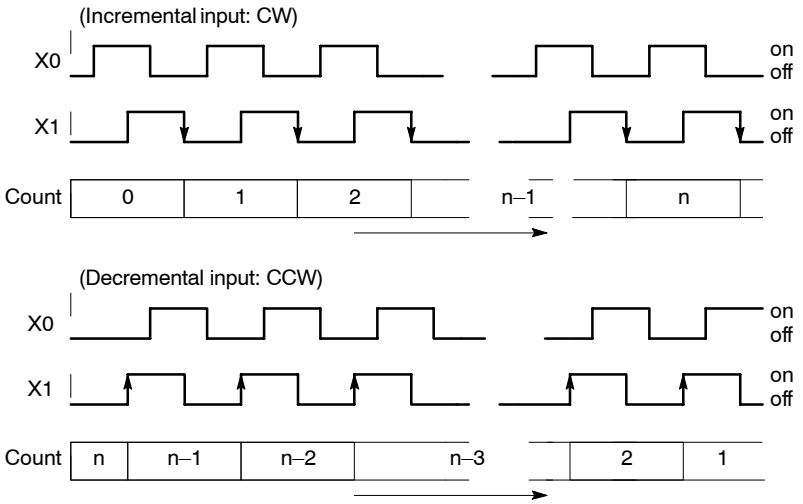
Incremental input mode



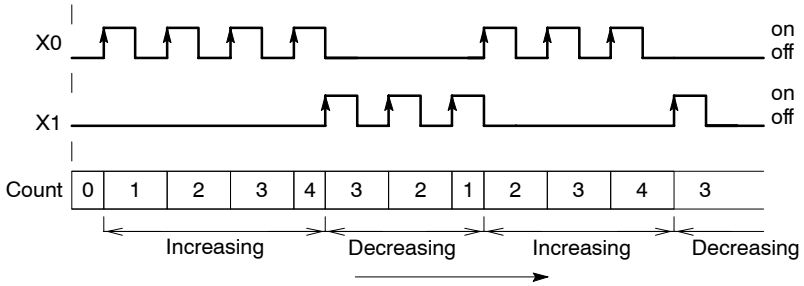
Decremental input mode



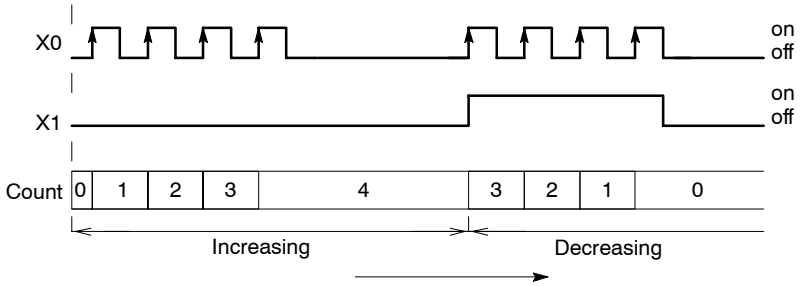
Two–phase input mode



Incremental/decremental input mode



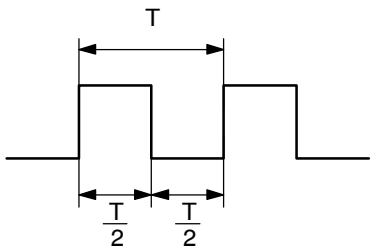
Incremental/decremental control input mode



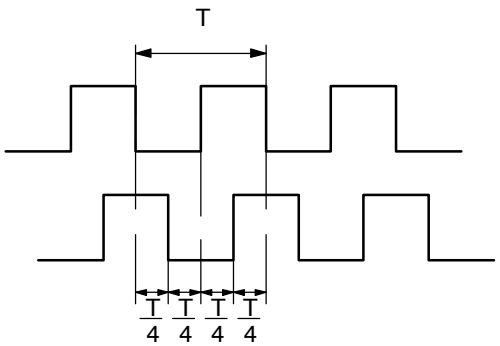
7.3.2 Minimum Input Pulse Width

For the period T (1/frequency), a minimum input pulse width of T/2 (single–phase input) or T/4 (two–phase input) is required.

Single–phase



Two–phase

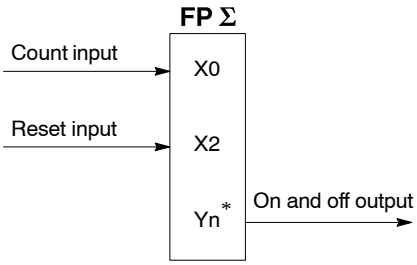


7.3.3 I/O Allocation

As shown in the specifications table (see page 7-4), the inputs and outputs used will differ depending on the channel number being used.

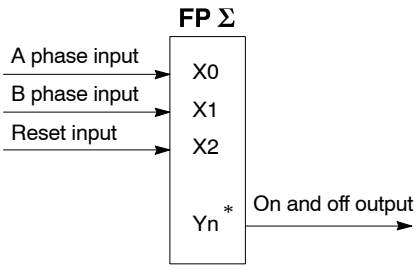
The output turned on and off can be specified from Y0 to Y7 as desired with the instructions **F166 (HC1S)** and **F167 (HC1R)**.

Using CH0 with incremental input and reset input



* The output turned on and off when the target value is reached can be specified from Y0 to Y7 as desired.

Using CH0 with two–phase input and reset input



* The output turned on and off when the target value is reached can be specified from Y0 to Y7 as desired.

7.3.4 Instructions

The following instructions can be used with the high–speed counter function:

7.3.4.1 High–Speed Counter Control Instruction F0

This instruction is used for counter operations such as software reset and count disable.

Specify this instruction together with the special data register DT90052.

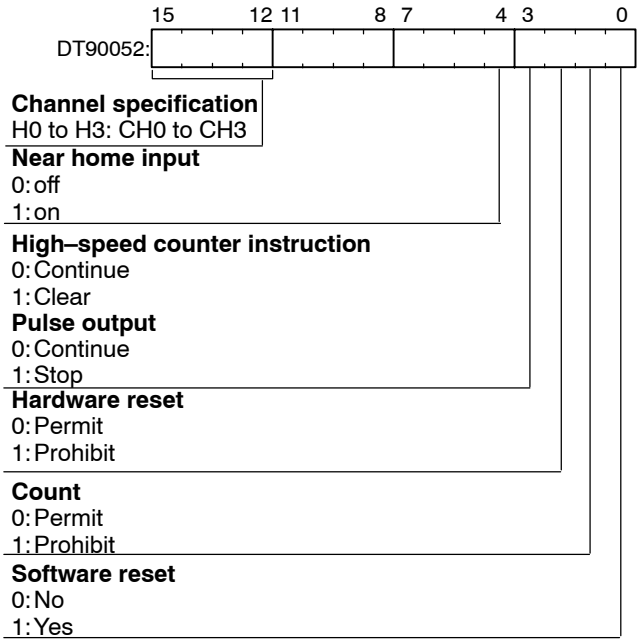
Once this instruction is executed, the settings will remain until this instruction is executed again.

Operations that can be performed with this instruction

- Counter software reset
- Counting operation enable/disable
- Hardware reset enable/disable
- Clear high–speed counter instructions **F166** to **F176**

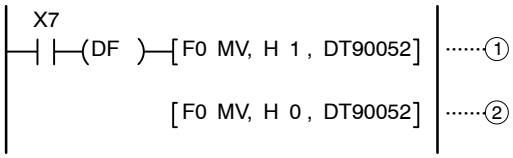
High–speed counter control flag area of FPΣ

The area DT90052 for writing channels and control codes is allocated as shown below. Control codes written with an **F0(MV)** instruction are stored by channel in special data registers DT90190 to DT90193.



Programming example: Performing a software reset

FPWIN GR:



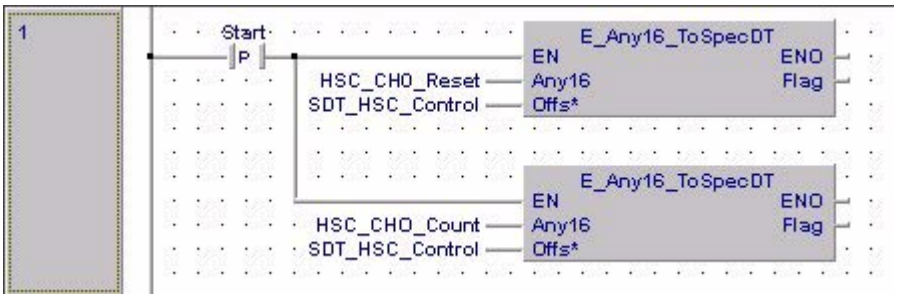
In the above program, the reset is performed in step ① and 0 is entered just after that in step ②. The count is now ready for operation. If it is only reset, counting will not be performed.

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Start	BOOL	FALSE	Activates the function
1	VAR_CONSTANT	HSC_CH0_Reset	WORD	16#0001	Resets channel 0
2	VAR_CONSTANT	HSC_CH0_Count	WORD	16#0000	Channel 0 starts counting
3	VAR_CONSTANT	SDT_HSC_Control	INT	52	Special data register DT90052

LD Body



The E_Any16_ToSpecDT instruction (NC Tool Library) uses the F0 instruction internally to copy PLC–independent data from the 16–bit variable at input Any16 to the special data register defined by the value at input Offs. The variable input Any16 is thus copied to the data register DT(9000+Offs) or DT(90000+Offs). For the high–speed counter in the FPΣ, this data register is DT90052. The output flag is not used.

7.3.4.2 Elapsed Value Write and Read Instruction F1

This instruction changes or reads the elapsed value of the high–speed counter.

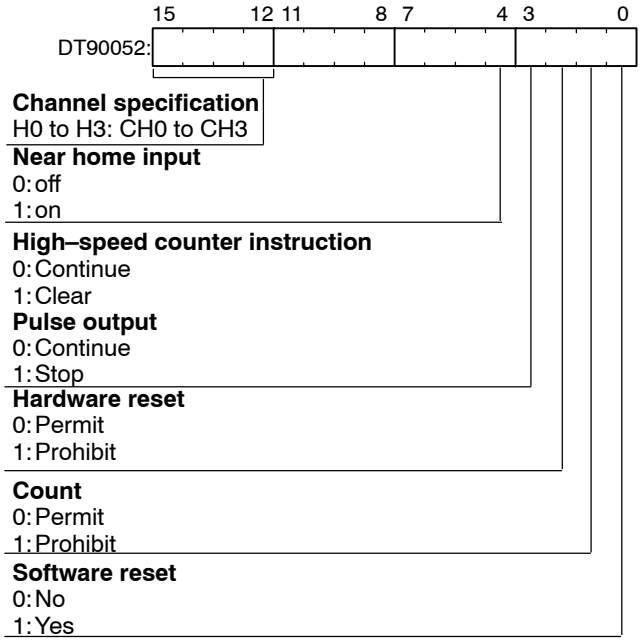
Specify this instruction together with the special data register DT90044.

The elapsed value is stored as 32–bit data in the combined area of special data registers DT90044 and DT90045.

Use the **F1 (DMV)** instruction to set the elapsed value.

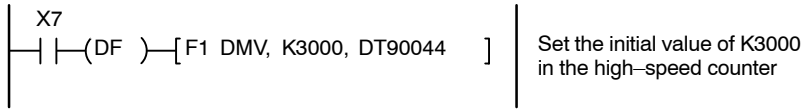
High–speed counter control flag area of FPΣ

The area DT90052 for writing channels and control codes is allocated as shown below. Control codes written with an **F0(MV)** instruction are stored by channel in special data registers DT90190 to DT90193.



Programming example 1: Changing the elapsed value

FPWIN GR:

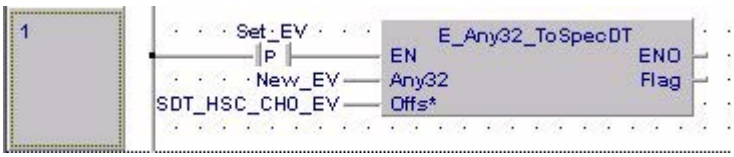


FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Set_EV	BOOL	FALSE	Activates the function
1	VAR	New_EV	DINT	3000	Initial value of HSC at 3000
2	VAR_CONSTANT	SDT_HSC_CH0_EV	INT	44	Offset to DDT90044

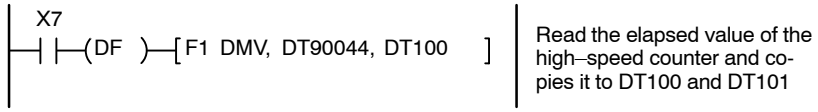
LD Body



The E_Any32_ToSpecDT instruction (NC Tool Library) uses the F1 instruction internally to copy PLC–independent data from the 32–bit variable at input Any32 to the special data register defined by the value at input Offs*. The variable input Any32 is thus copied to the data register DDT(9000+Offs) or DDT(90000+Offs). The output flag is not used.

Programming example 2: Reading the elapsed value

FPWIN GR:



FPWIN Pro:

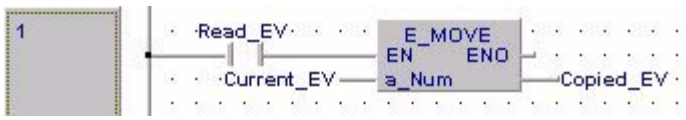
GVL

	Class	Identifier	Matsushit	IEC_Address	Type	Initial	Au	Comment
0	VAR_GLOBAL	Current_EV	DDT90044	%MD5.90044	DINT	0		Address of elapsed value

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	Current_EV	DINT	0	Address of elapsed value
1	VAR	Read_EV	BOOL	FALSE	Reads elapsed value
2	VAR	Copied_EV	DINT	0	Outputs elapsed value

LD Body



Alternatively to the E_MOVE command, the commands E_SpecDT_ToAny32 or F1_DMV can be used.

7.3.4.3 Target Value Match ON Instruction F166

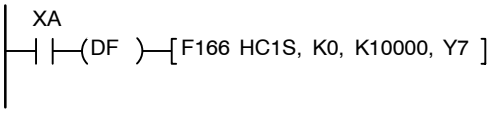
GVL

The global variable list applies to the two following FPWIN Pro programming examples.

	Class	Identifier	Mats	IEC_Addr	Type	Initial
0	VAR_GLOBAL	Output6	Y6	%QX0.6	BOOL	FALSE
1	VAR_GLOBAL	Output7	Y7	%QX0.7	BOOL	FALSE

Programming example 1:

FPWIN GR:



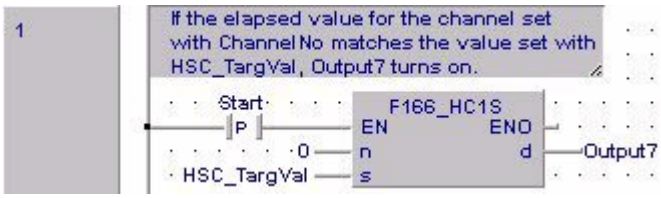
If the elapsed value (DT90044 and DT90045) for channel 0 matches K10000, output Y7 turns on.

FPWIN Pro:

POU Header

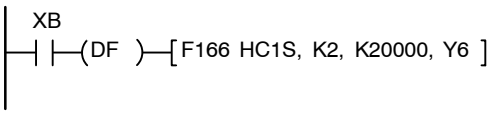
	Class	Identifier	Type	Initial	Comment
0	VAR	Start	BOOL	FALSE	Activates the function
1	VAR	HSC_TargVal	DINT	10000	Sets target value to 10000
2	VAR_EXTERNAL	Output7	BOOL	FALSE	

LD Body



Programming example 2:

FPWIN GR:



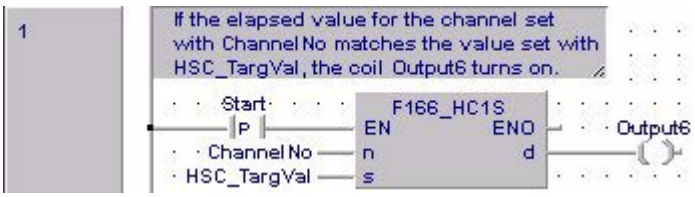
If the elapsed value (DT90200 and DT90201) for channel 2 matches K20000, output Y6 turns on.

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Start	BOOL	FALSE	Activates the function
1	VAR	ChannelNo	DINT	2	Sets channel number 2
2	VAR	HSC_TargVal	DINT	20000	Sets target value at 20000
3	VAR_EXTERNAL	Output6	BOOL	FALSE	

LD Body



Note

In FPWIN Pro, the argument 'n' can also be a variable.

7.3.4.4 Target Value Match OFF Instruction F167

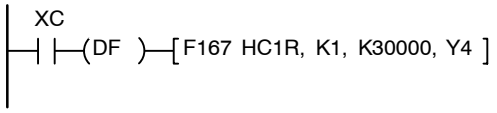
GVL

The global variable list applies to the two following FPWIN Pro programming examples.

	Class	Identifier	Ma	IEC_Ad	Type	Initial
0	VAR_GLOBAL	Ouput4	Y4	%QX0.4	BOOL	FALSE
1	VAR_GLOBAL	Ouput5	Y5	%QX0.5	BOOL	FALSE

Programming example 1:

FPWIN GR:



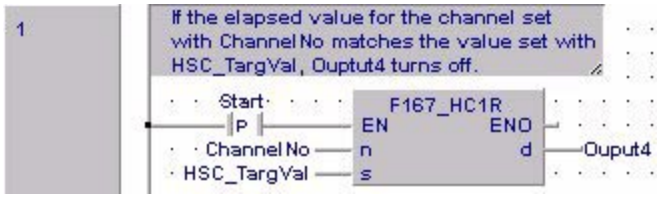
If the elapsed value (DT90048 and DT90049) for channel 1 matches K30000, output Y4 turns off.

FPWIN Pro:

POU Header

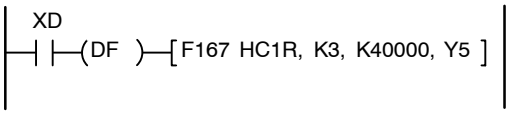
	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	Ouput4	BOOL	FALSE	
1	VAR	Start	BOOL	FALSE	Activates the function
2	VAR	Channel No	DINT	1	Sets channel number
3	VAR	HSC_TargVal	DINT	30000	Sets target value

LD Body



Programming example 2:

FPWIN GR:



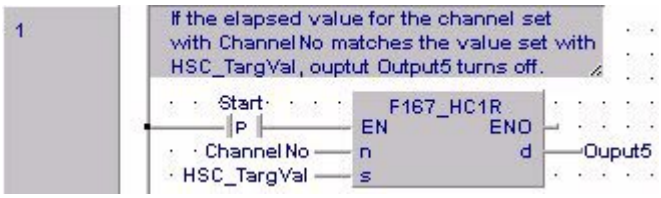
If the elapsed value (DT90204 and DT90205) for channel 3 matches K40000, output Y5 turns off.

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	Ouput5	BOOL	FALSE	
1	VAR	Start	BOOL	FALSE	Activates the function
2	VAR	Channel No	DINT	3	Sets channel number
3	VAR	HSC_TargVal	DINT	40000	Sets target value

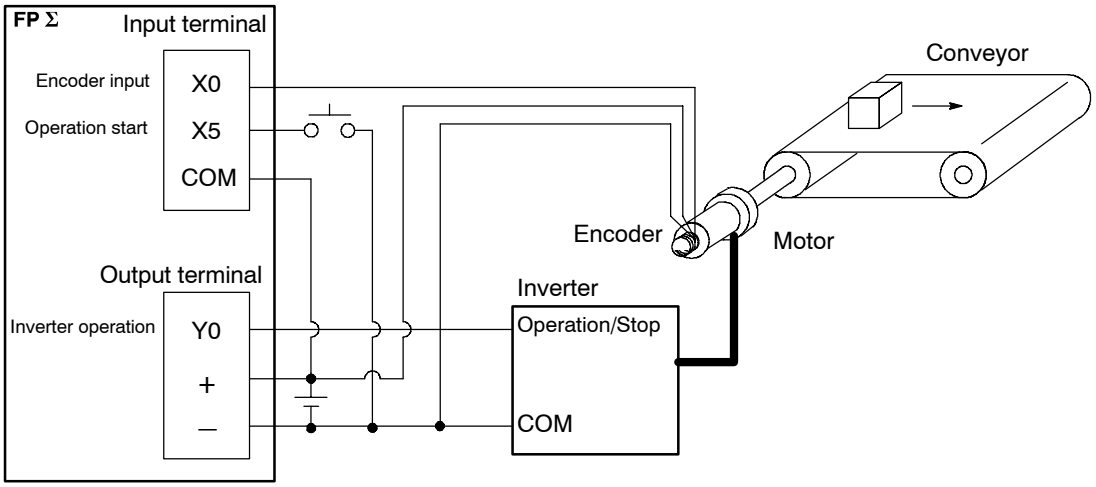
LD Body



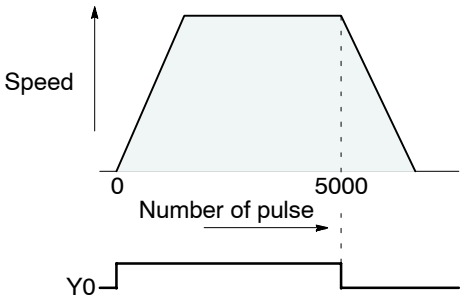
7.3.5 Sample Programs

7.3.5.1 Positioning Operations With Single–Speed Inverter

Wiring example



Operation chart

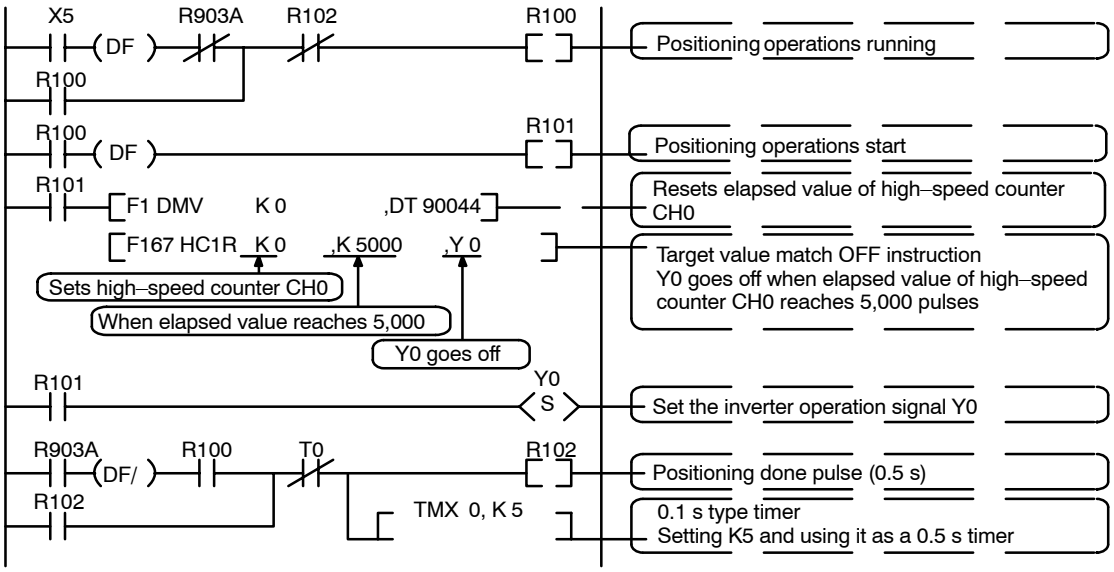


I/O allocation

I/O No.	Description
X0	Encoder input
X5	Operation start signal
Y0	Inverter operation signal
R100	Positioning operation running
R101	Positioning operation start
R102	Positioning done pulse
R903A	High–speed counter CH0 control flag

FPWIN GR:

When X5 is turned on, Y0 turns on and the conveyor begins moving. When the elapsed value (DT90044 and DT90045) reaches K5000, Y0 turns off and the conveyor stops.



FPWIN Pro:

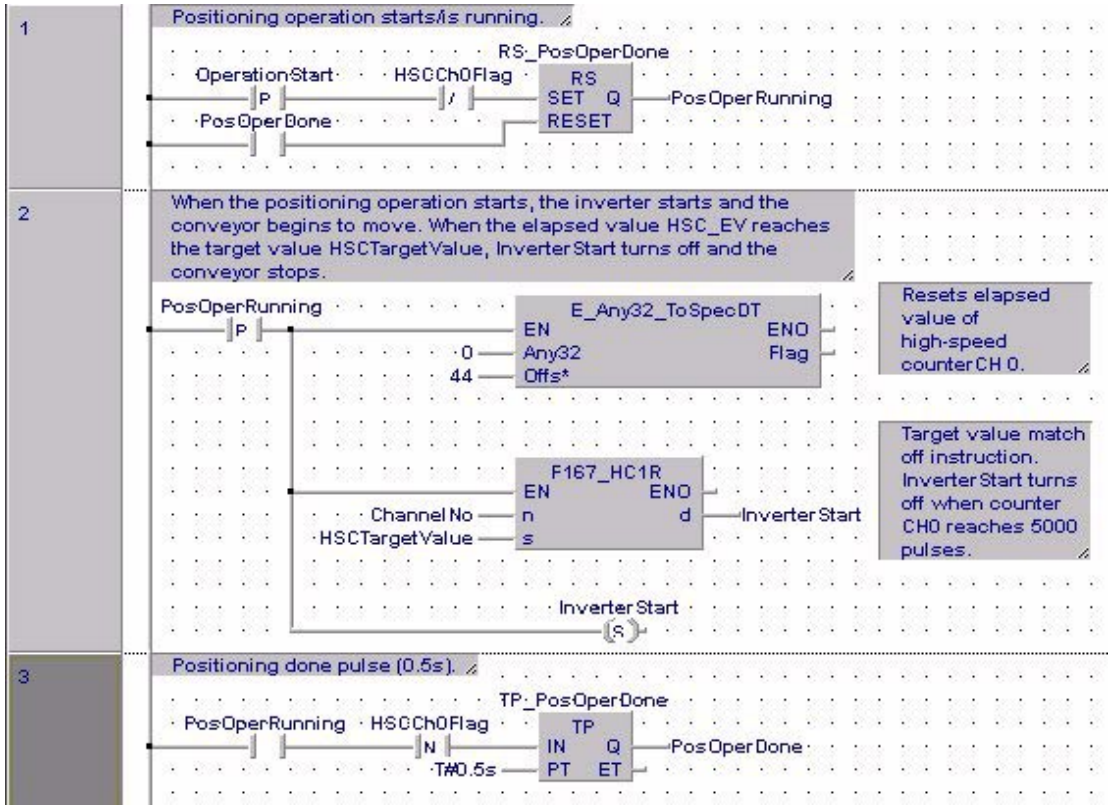
GVL

	Class	Identifier	Matsus	IEC_Address	Type	Initial	Au	Comment
0	VAR_GLOBAL	OperationStart	X5	%IX0.5	BOOL	FALSE	X	Activates operation
1	VAR_GLOBAL	InverterStart	Y0	%QX0.0	BOOL	FALSE	X	Starts inverter
2	VAR_GLOBAL	HSCCh0Flag	R903A	%MX0.903.10	BOOL	FALSE	X	High-speed counter channel 0 flag

POU Header

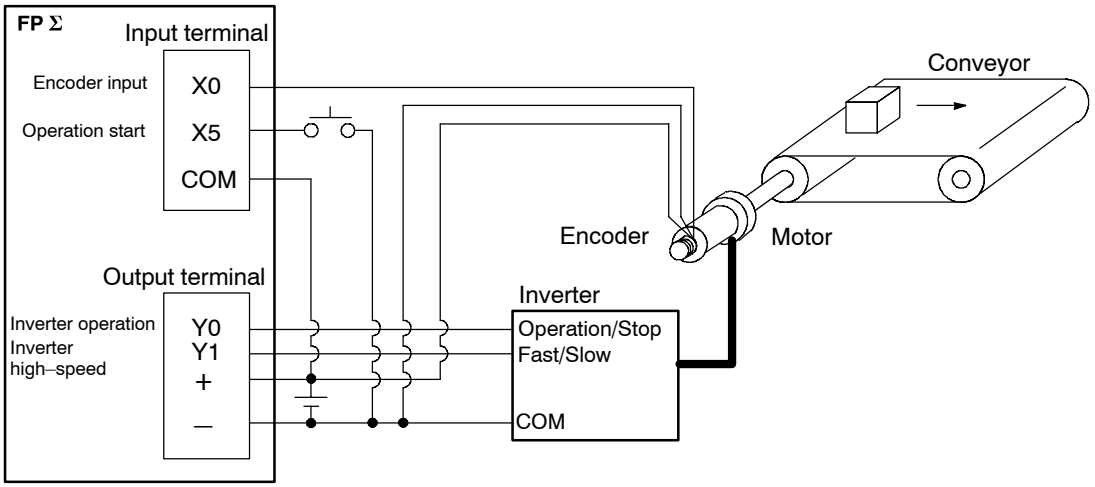
	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	OperationStart	BOOL	FALSE	Operation start signal
1	VAR_EXTERNAL	InverterStart	BOOL	FALSE	Inverter operation signal
2	VAR_EXTERNAL	HSCCh0Flag	BOOL	FALSE	High-speed counter Ch 0 control flag
3	VAR	PosOperRunning	BOOL	FALSE	Positioning operation running
4	VAR	PosOperDone	BOOL	FALSE	Positioning done pulse
5	VAR	HSCTargetValue	DINT	5000	High-speed counter target value
6	VAR	ChannelNo	DINT	0	Sets variable channel number
7	VAR	RS_PosOperDone	RS		
8	VAR	TP_PosOperDone	TP		

LD Body

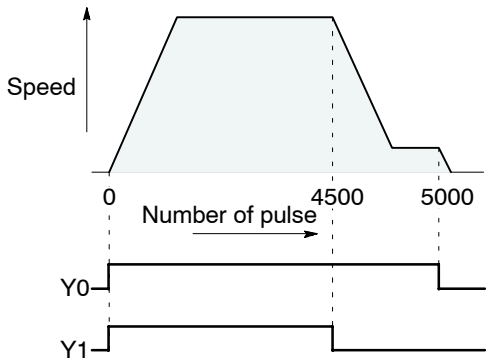

1
Positioning operation starts/is running.
RS_PosOperDone
OperationStart
P
HSCCh0Flag
/
RS
SET Q
RESET
PosOperRunning
PosOperDone
2
When the positioning operation starts, the inverter starts and the conveyor begins to move. When the elapsed value HSC_EV reaches the target value HSCTargetValue, InverterStart turns off and the conveyor stops.
PosOperRunning
P
E_Any32_ToSpecDT
EN
ENO
0
Any32
Flag
44
Offs*
Resets elapsed value of high-speed counter CH 0.
F167_HC1R
EN
ENO
ChannelNo
n
d
InverterStart
HSCTargetValue
s
Target value match off instruction. InverterStart turns off when counter CH0 reaches 5000 pulses.
InverterStart
S
3
Positioning done pulse (0.5s).
TP_PosOperDone
PosOperRunning
HSCCh0Flag
N
TP
IN Q
T#0.5s
PT ET
PosOperDone

7.3.5.2 Positioning Operations With Double–Speed Inverter

Wiring example



Operation chart

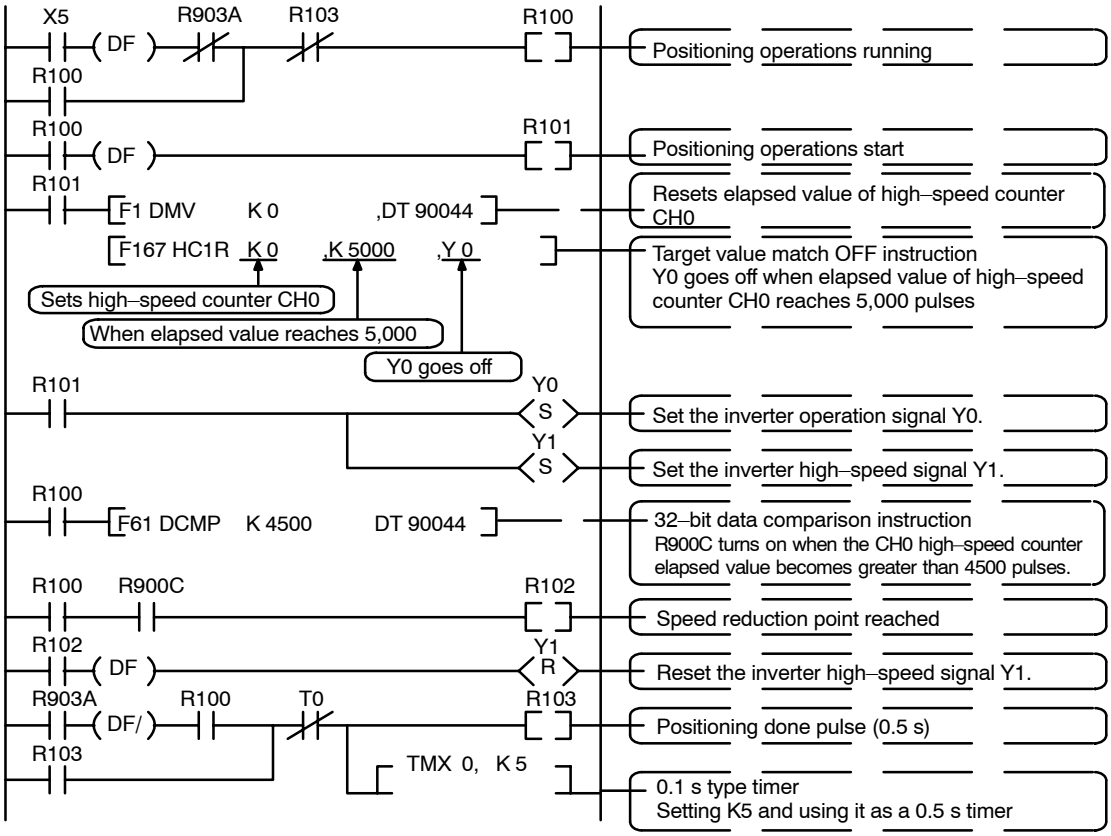


I/O allocation

I/O No.	Description
X0	Encoder input
X5	Operation start signal
Y0	Inverter operation signal
Y1	Inverter high–speed signal
R100	Positioning operation running
R101	Positioning operation start
R102	Arrival at deceleration point
R103	Positioning done pulse
R900C	Comparison instruction “<” flag
R903A	High–speed counter CH0 control flag

FPWIN GR:

When X5 is turned on, Y0 and Y1 turn on and the conveyor begins moving. When the elapsed value (DT90044 and DT90045) reaches K4500, Y1 turns off and the conveyor begins decelerating. When the elapsed value reaches K5000, Y0 turns off and the conveyor stops.



FPWIN Pro:

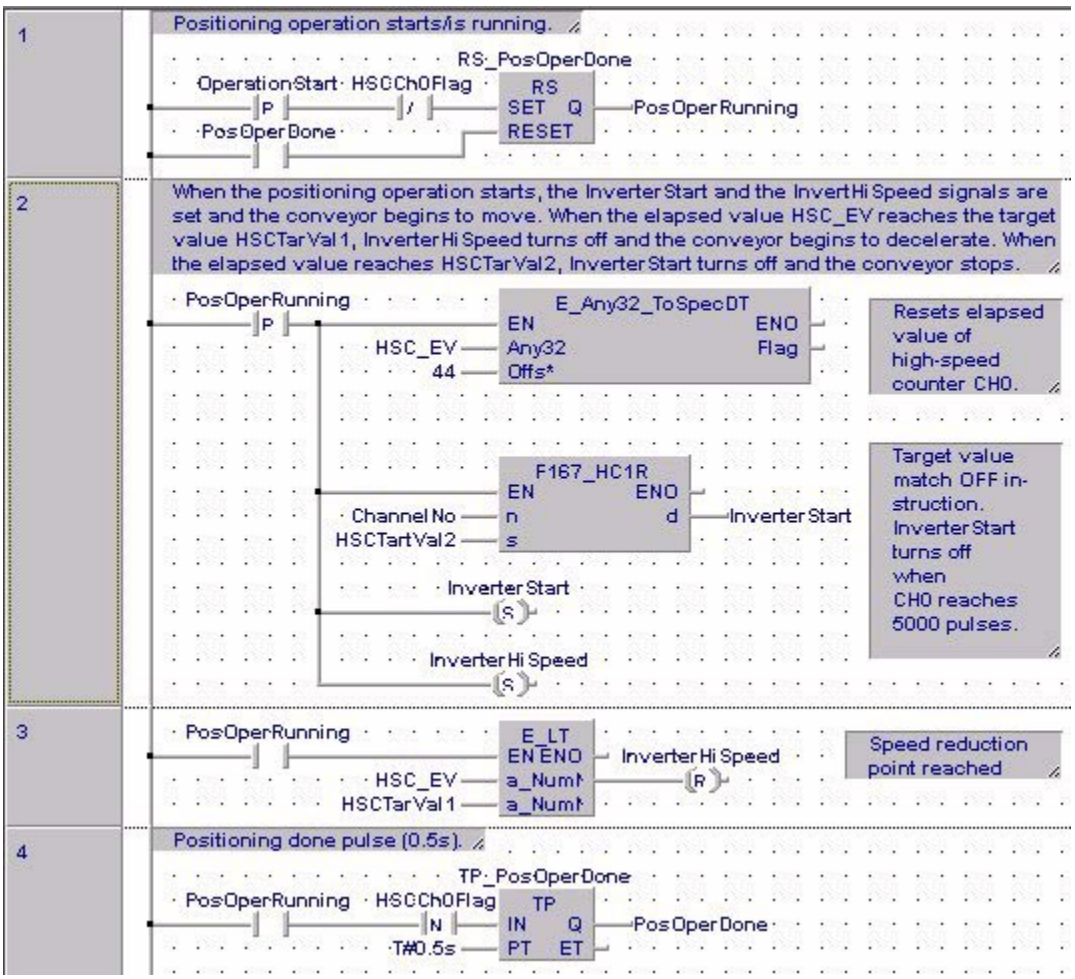
GVL

	Class	Identifier	Matsus	IEC_Addr	Type	Initial	Au	Comment
0	VAR_GLOBAL	OperationStart	X5	%IX0.5	BOOL	FALSE	X	Activates operation
1	VAR_GLOBAL	InverterStart	Y0	%QX0.0	BOOL	FALSE	X	Inverter operation signal
2	VAR_GLOBAL	InverterHiSpeed	Y1	%QX0.1	BOOL	FALSE	X	Inverter high-speed signal
3	VAR_GLOBAL	HSCCh0Flag	R903A	%MX0.903	BOOL	FALSE	X	High-speed counter channel 0 flag

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	OperationStart	BOOL	FALSE	Operation start signal
1	VAR_EXTERNAL	InverterStart	BOOL	FALSE	Inverter operation signal
2	VAR_EXTERNAL	HSCCh0Flag	BOOL	FALSE	High-speed counter Ch 0 control flag
3	VAR_EXTERNAL	InverterHiSpeed	BOOL	FALSE	Inverter high-speed signal
4	VAR	PosOperRunning	BOOL	FALSE	Positioning operation running
5	VAR	PosOperDone	BOOL	FALSE	Positioning done pulse
6	VAR	HSC_EV	DINT	0	High-speed counter elapsed value
7	VAR	HSCTarVal1	DINT	4500	High-speed counter target value 1
8	VAR	HSCTartVal2	DINT	5000	High-speed counter target value 2
9	VAR	ChannelNo	DINT	0	Sets channel number
10	VAR	RS_PosOperDone	RS		
11	VAR	TP_PosOperDone	TP		

LD Body


1
Positioning operation starts/is running.
RS:_PosOperDone
OperationStart
HSCCh0Flag
P
/
RS
SET Q
RESET
PosOperRunning
PosOperDone
2
When the positioning operation starts, the InverterStart and the InvertHiSpeed signals are set and the conveyor begins to move. When the elapsed value HSC_EV reaches the target value HSCTarVal1, InverterHiSpeed turns off and the conveyor begins to decelerate. When the elapsed value reaches HSCTarVal2, InverterStart turns off and the conveyor stops.
PosOperRunning
P
E_Any32_ToSpecDT
EN
ENO
HSC_EV
Any32
Flag
44
Offs*
Resets elapsed value of high-speed counter CH0.
F167_HC1R
EN
ENO
ChannelNo
n
d
InverterStart
HSCTartVal2
s
Target value match OFF instruction. InverterStart turns off when CH0 reaches 5000 pulses.
InverterStart
S
InverterHiSpeed
S
3
PosOperRunning
E_LT
EN ENO
HSC_EV
a_Num1
InverterHiSpeed
R
HSCTarVal1
a_Num2
Speed reduction point reached
4
Positioning done pulse (0.5s).
TP:_PosOperDone
PosOperRunning
HSCCh0Flag
N
TP
IN Q
T#0.5s
PT ET
PosOperDone

7.4 Pulse Output Function

Together with a commercially available pulse–string input type motor driver, the pulse output function can be used for positioning control.

It provides trapezoidal (table–shaped) control with the FPΣ instruction **F171 (SPDH)**. By specifying the initial speed, maximum speed, acceleration/deceleration time, and target value, pulse outputs are automatically obtained.

F171 (SPDH) also allows automatic home return operation.

The FPΣ instruction **F172 (PLSH)** can be used for JOG operation: Pulses are output as long as the execution condition is on. A target value can also be set, so that pulse output stops when the target value is reached.

With the FPΣ instruction **F174 (PL0H)**, pulse output according to a data table, and with this, positioning control is possible.

The FPΣ instruction **F175 (SPSH)** is available for linear interpolation control. For this, the composite speed, the acceleration/deceleration time, and the target value need to be specified.

The FPΣ instruction **F176 (SPCH)** is available for circular interpolation control. The user can select one of two arc forming methods, one by specifying a pass position and the other by specifying a center position.

Notes

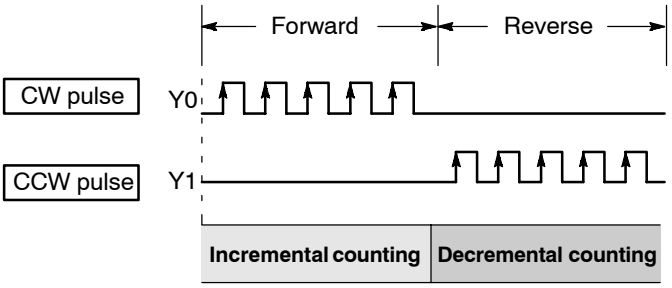
- **When using the pulse output instructions F171, F172, F174 and F175, specify the initial frequency to 30 kHz or less. Otherwise the first pulse may be lost.**
- **The linear interpolation control instruction F175(SPSH) and circular interpolation control instruction F176(SPCH) can only be used with transistor output type control unit version 2 or higher.**

Setting system registers

When using the pulse output function, set the channels with system registers 400 and 401 to “High–speed counter (HSC) not used” (FPWIN Pro)/“Do not use high–speed counter” (FPWIN GR).

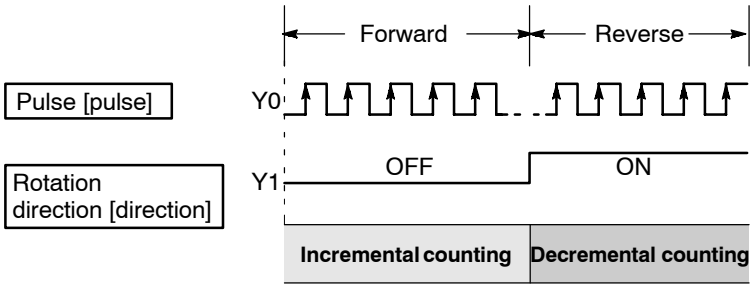
7.4.1 Pulse Output Methods

Clockwise/counter–clockwise output method



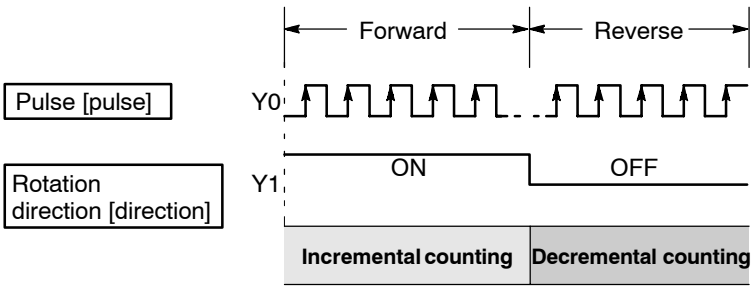
Control is carried out using two pulses: a forward rotation pulse and a reverse rotation pulse.

Pulse/direction output method (forward: OFF/reverse: ON)



Control is carried out using one pulse output to specify the speed and another to specify the direction of rotation with on/off signals. In this mode, forward rotation is carried out when the rotation direction signal is OFF.

Pulse/direction output method (forward: ON/reverse: OFF)



Control is carried out using one pulse output to specify the speed and another to specify the direction of rotation with on/off signals. In this mode, forward rotation is carried out when the rotation direction signal is ON.

7.4.2 I/O Allocation

The I/O allocation of pulse output terminals and home input is determined by the channel used. (For table of specifications, see page 7-5.)

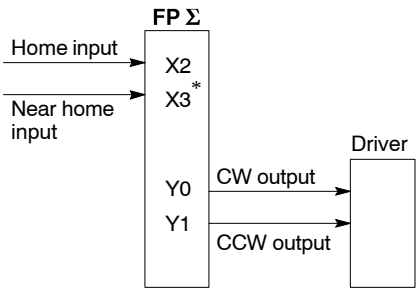
The near home input is allocated by designating the desired contact and turning on and off the specified bit of special data register DT90052.

Double pulse input driver (CW pulse input and CCW pulse input method)

Two output contacts are used as a pulse output for CW/CCW.

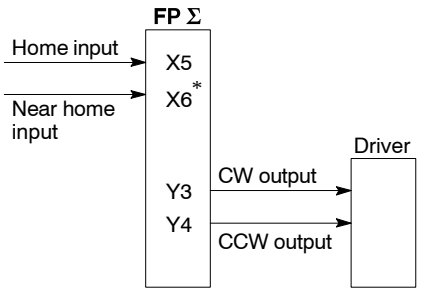
Set the control code for **F171 (SPDH)** to CW/CCW.

Using CH0



* X3 or any other input can be specified for the near home input.

Using CH2



* X6 or any other input can be specified for the near home input.

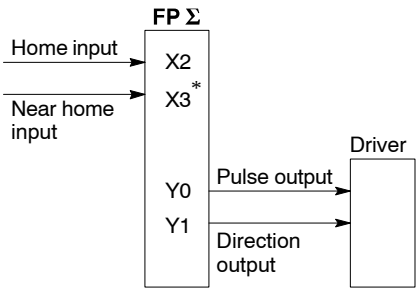
Single pulse input driver (pulse input and direction input method)

One output point is used as a pulse output and the other output is used as a direction output.

Set the control code for **F171 (SPDH)** to pulse and direction.

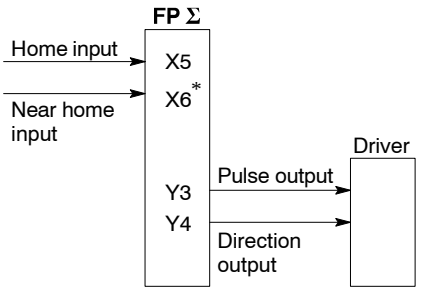
Up to two driver systems can be connected.

Using CH0



* X3 or any other input can be specified for the near home input.

Using CH2



* X6 or any other desired input can be specified for the near home input.

7.4.3 Control Mode

Incremental position control

Outputs the pulses set with the target value.

Selected mode / Target value	CW/CCW	Pulse and direction forward OFF/ reverse ON	Pulse and direction forward ON/ reverse OFF	HSC counting method
Positive	Pulse output from CW	Pulse output when direction output is OFF	Pulse output when direction output is ON	Incremental
Negative	Pulse output from CCW	Pulse output when direction output is ON	Pulse output when direction output is OFF	Decremental

Absolute position control

Outputs a number of pulses equal to the difference between the set target value and the current value.

Selected mode / Target value	CW/CCW	Pulse and direction forward OFF/ reverse ON	Pulse and direction forward ON/ reverse OFF	HSC counting method
Target value greater than current value	Pulse output from CW	Pulse output when direction output is OFF	Pulse output when direction output is ON	Incremental
Target value less than current value	Pulse output from CCW	Pulse output when direction output is ON	Pulse output when direction output is OFF	Decremental

Home return

When executing the **F171 (SPDH)** instruction, the pulse is continuously output until the home input (X2 or X5) is enabled.

To decelerate the movement when near the home position, designate a near home input and set bit 4 of special data register DT90052 to off → on → off.

The deviation counter clear output can be output when home return has been completed.

JOG operation

Pulses are output from the specified channel while the trigger for the **F172 (PLSH)** instruction is in the ON state.

The direction output and output frequency are specified by the **F172 (PLSH)** instruction.

7.4.4 Instructions

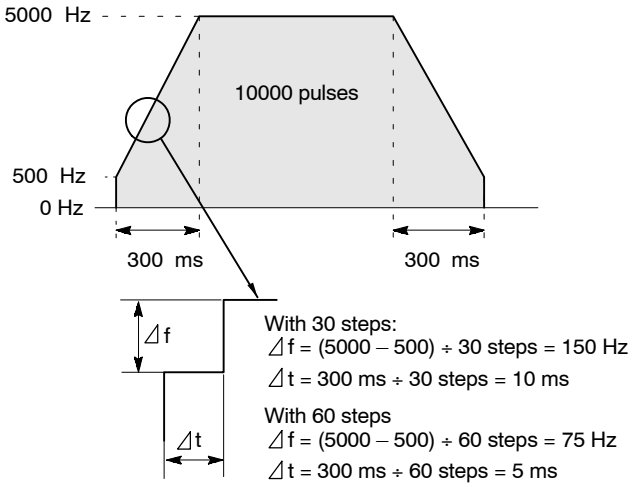
The following instructions can be used with the pulse output function:

7.4.4.1 Positioning Control Instruction F171 – Trapezoidal Control

This instruction automatically performs trapezoidal control according to the specified data table.

Programming example: **Pulses are generated from output Y0 at an initial speed of 500 Hz, a maximum speed of 5,000 Hz, an acceleration/deceleration time of 300 ms, and a movement amount of 10,000 pulses.**

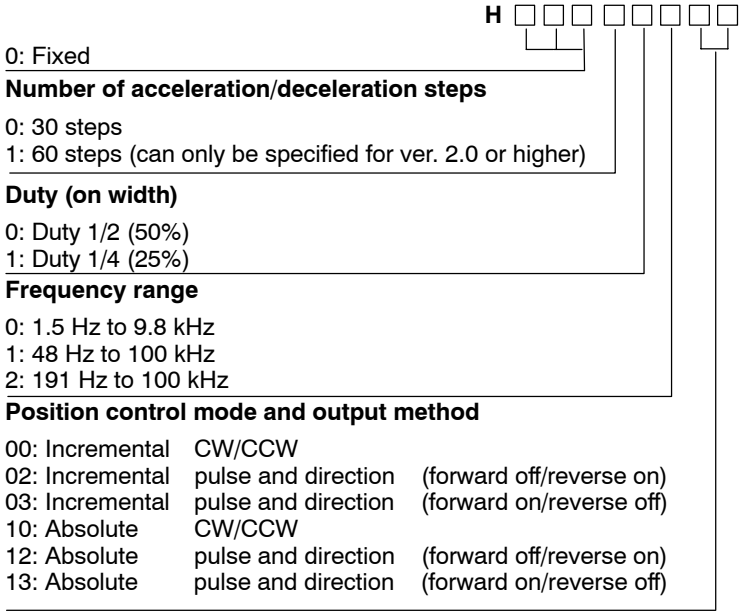
Pulse output diagram


5000 Hz
10000 pulses
500 Hz
0 Hz
300 ms
300 ms
⊿f
⊿t
With 30 steps:
⊿f = (5000 – 500) ÷ 30 steps = 150 Hz
⊿t = 300 ms ÷ 30 steps = 10 ms
With 60 steps
⊿f = (5000 – 500) ÷ 60 steps = 75 Hz
⊿t = 300 ms ÷ 60 steps = 5 ms

Positioning data table

DT100 **DT101**	Control code *1	:H 1100
DT102 **DT103**	Initial speed *2	:500 Hz
DT104 **DT105**	Maximum speed *2	:5,000 Hz
DT106 **DT107**	Acceleration/deceleration time *3	:300 ms
DT108 **DT109**	Target value *4	:10,000 pulses
DT110 **DT111**	Pulse stop	:K0

(*1): Control code (H constant)


H □□□ □□□□ □□
0: Fixed
Number of acceleration/deceleration steps
0: 30 steps
1: 60 steps (can only be specified for ver. 2.0 or higher)
Duty (on width)
0: Duty 1/2 (50%)
1: Duty 1/4 (25%)
Frequency range
0: 1.5 Hz to 9.8 kHz
1: 48 Hz to 100 kHz
2: 191 Hz to 100 kHz
Position control mode and output method
00: Incremental CW/CCW
02: Incremental pulse and direction (forward off/reverse on)
03: Incremental pulse and direction (forward on/reverse off)
10: Absolute CW/CCW
12: Absolute pulse and direction (forward off/reverse on)
13: Absolute pulse and direction (forward on/reverse off)

(*2): Frequency (Hz) K constant
1.5 Hz to 9.8 KHz [K1 to K9800 (unit: Hz)] (max. error near 9.8 kHz approx. –0.9 kHz)
* Set K1 to specify 1.5 Hz.
48 Hz to 100 KHz [K48 to K100000 (unit: Hz)] (max. error near 100 kHz approx. –3 kHz)
191 Hz to 100 KHz [K191 to K100000 (unit: Hz)] (max. error near 100 kHz approx. –0.8 kHz)
Specify the initial frequency to 30 kHz or less.

(*3): Acceleration/deceleration time (ms) K constant
With 30 steps: K30 to K32767
With 60 steps: K36 to K32767

(*4): Target value K constant
K–2147483648 to K2147483647

Acceleration/deceleration time setting

Set the acceleration/deceleration time so that it is the same or greater than the value of the following formula.

Acceleration/deceleration time t (ms) > Steps x 100/Frequency f (Hz)

Depending on the number of steps, the acceleration/deceleration time may sometimes be longer than the set value.

Example:

According to the following calculation, when the acceleration/deceleration time is 100 ms and the number of steps is 30, the actual acceleration/deceleration time will be 120 ms.
100 ms / 30 steps = 3.3 ms → 4 ms
4 ms x 30 steps = 120 ms

FPWIN GR:

```
X8
─┤├─(DF )─[ F1 DMV, H1100,  DT100  ]
        [ F1 DMV, K500,   DT102  ]
        [ F1 DMV, K5000,  DT104  ]
        [ F1 DMV, K300,   DT106  ]
        [ F1 DMV, K10000, DT108  ]
        [ F1 DMV, K0,     DT110  ]
        [ F171 SPDH, DT100, K0   ]
```

FPWIN Pro:

DUT

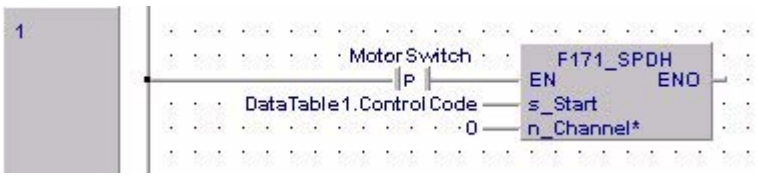
F171_DUT [DUT]

	Identifier	Type	Initial	Comment
0	Control Code	DWORD	0	Highest WORD fixed to 0000 Lowest WORD = Control code
1	Initial Speed	DINT	0	Initial speed (Hz)
2	Maximum Speed	DINT	0	Maximum speed (Hz)
3	Accel Time	DINT	0	Acceleration/deceleration time (ms)
4	Target Val	DINT	0	Target value, no. of pulses
5	Pulse Stop	DINT	0	End of data table

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Motor Switch	BOOL	FALSE	
1	VAR	DataTable1	F171_DUT	Control Code := 16#1100, Initial Speed := 500, Maximum Speed := 5000, Accel Time := 300, Target Val := 10000, Pulse Stop := 0	Control code 16#1100= 1 = 25% Duty 1 = 48Hz to 100kHz 00 = Incremental CW/CCW

LD Body

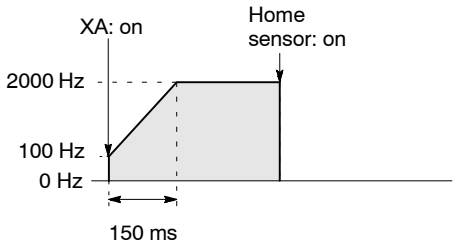


7.4.4.2 Positioning Control Instruction F171 – Home Return

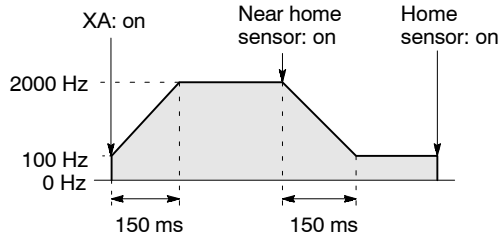
This function performs home return according to the specified data table.

Programming example: **Pulses are output from Y1 and a return to the home position is carried out at an initial speed of 100 Hz, a maximum speed of 2,000 Hz, and an acceleration/deceleration time of 150 ms.**

Pulse output diagram (without near home input)



Pulse output diagram (with near home input)



Positioning data table

DT200 **DT201**	Control code *1	:H 1121
DT202 **DT203**	Initial speed *2	:100 Hz
DT204 **DT205**	Maximum speed *2	:2000 Hz
DT206 **DT207**	Acceleration/deceleration time *3	:150 ms
DT208 **DT209**	Deviation counter clear signal *4	:Not used

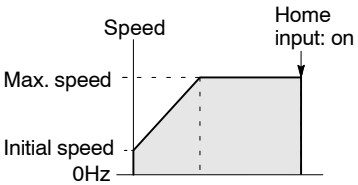
Home return operation modes

There are two operation modes for a home return with the FPΣ: Type I and Type II.

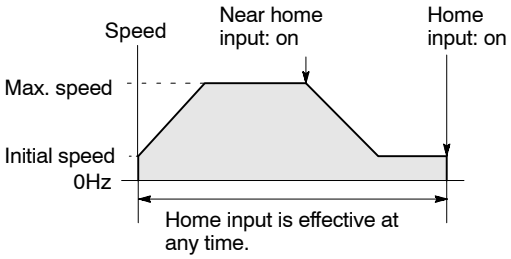
Type I home return

The home input is effective regardless of whether or not there is a near home input, whether deceleration is taking place, or whether deceleration has been completed.

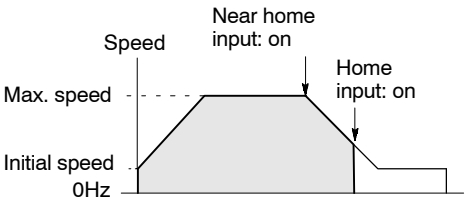
Without near home input



With near home input

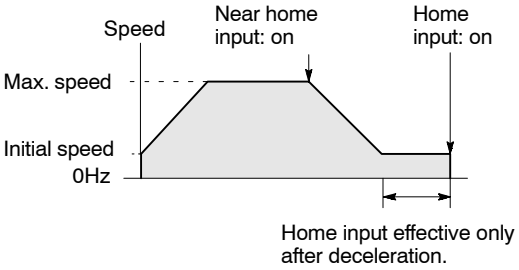


Home input ON during deceleration

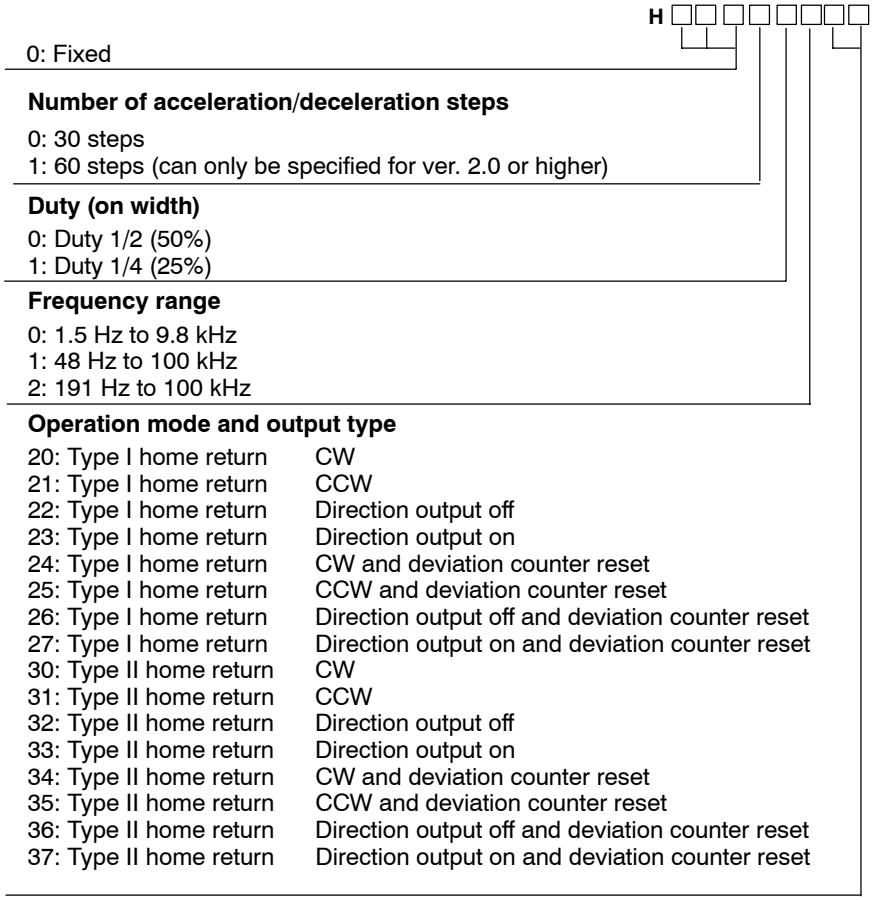


Type II home return

In this mode, the home input is effective only after deceleration (started by near home input) has been completed.



(*1): Control code (H constant)


H □□□□□□□□
0: Fixed
Number of acceleration/deceleration steps
0: 30 steps
1: 60 steps (can only be specified for ver. 2.0 or higher)
Duty (on width)
0: Duty 1/2 (50%)
1: Duty 1/4 (25%)
Frequency range
0: 1.5 Hz to 9.8 kHz
1: 48 Hz to 100 kHz
2: 191 Hz to 100 kHz
Operation mode and output type
20: Type I home return CW
21: Type I home return CCW
22: Type I home return Direction output off
23: Type I home return Direction output on
24: Type I home return CW and deviation counter reset
25: Type I home return CCW and deviation counter reset
26: Type I home return Direction output off and deviation counter reset
27: Type I home return Direction output on and deviation counter reset
30: Type II home return CW
31: Type II home return CCW
32: Type II home return Direction output off
33: Type II home return Direction output on
34: Type II home return CW and deviation counter reset
35: Type II home return CCW and deviation counter reset
36: Type II home return Direction output off and deviation counter reset
37: Type II home return Direction output on and deviation counter reset

(*2): Frequency (Hz) K constant

1.5 Hz to 9.8 KHz [K1 to K9800 (unit: Hz)] (max. error near 9.8 kHz approx. –0.9 kHz)
* Set K1 to specify 1.5 Hz.
48 Hz to 100 KHz [K48 to K100000 (unit: Hz)] (max. error near 100 kHz approx. –3 kHz)
191 Hz to 100 KHz [K191 to K100000 (unit: Hz)] (max. error near 100 kHz approx. –0.8 kHz)
Specify the initial frequency to 30 kHz or less.

(*3): Acceleration/deceleration time (ms) K constant

With 30 steps: K30 to K32767
With 60 steps: K36 to K32767

(*4): Deviation counter clear signal (ms) K constant

0.5 ms to 100 ms [K0 to K100] Set value and margin of error (0.5 ms or less)
Specify K0 when not using this signal or when specifying 0.5 ms

Acceleration/deceleration time setting

Set the acceleration/deceleration time so that it is the same or greater than the value of the following formula.

Acceleration/deceleration time t (ms) > Steps x 100/Frequency f (Hz)

Depending on the number of steps, the acceleration/deceleration time may sometimes be longer than the set value.

Example:

According to the following calculation, when the acceleration/deceleration time is 100 ms and the number of steps is 30, the actual acceleration/deceleration time will be 120 ms.

100 ms / 30 steps = 3.3 ms → 4 ms
4 ms x 30 steps = 120 ms

FPWIN GR:

```
XA
─┤ ├─(DF )─┤[ F1 DMV, H1121,  DT200 ]
          [ F1 DMV, K100,   DT202 ]
          [ F1 DMV, K2000,  DT204 ]
          [ F1 DMV, K150,   DT206 ]
          [ F1 DMV, K0,     DT208 ]
          [ F171 SPDH, DT200, K0  ]
```

FPWIN Pro:

DUT

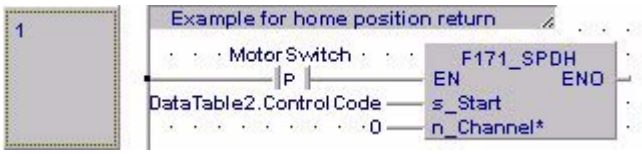
MotorDataHome [DUT]

	Identifier	Type	Initial	Comment
0	Control Code	DWORD	0	Highest WORD fixed to 0000 Lowest WORD = Control Code
1	Fmin	DINT	0	Initial frequency (Hz)
2	Fmax	DINT	0	Target frequency (Hz)
3	AccelTime	DINT	0	Time between Fmin and Fmax in ms
4	DeviationSignal	DINT	0	Deviation counter clear signal in ms

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	MotorSwitch	BOOL	FALSE	
1	VAR	DataTable2	MotorDataHome	Control Code := 16#1121, Fmin := 100, Fmax := 2000, AccelTime := 150	For Control Code (16#1121): 1 = 25% duty 1 = 48 to 100 kHz 21 = Home position return type I CCW

LD Body

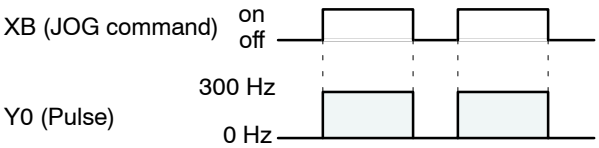


7.4.4.3 Pulse Output Instruction F172 – JOG Operation

This instruction is used for JOG operation by obtaining a pulse from the desired output when the execution condition (trigger) turns on.

Programming example: While XB is ON, a pulse of 300Hz is output from Y0.

Pulse output diagram



Data table

DT300 **DT301**	Control code *1	:H 1110
DT302 **DT303**	Frequency *2	:300 Hz

(*1): Control code (H constant)

H□□□□□□□□

0: Fixed

Target value setting (*3)

0: Mode with no target value
1: Target value match stop mode
(can only be specified for ver. 2.0 or higher)

Duty (on width)

0: Duty 1/2 (50%)
1: Duty 1/4 (25%)

Frequency range

0: 1.5 Hz to 9.8 kHz
1: 48 Hz to 100 kHz
2: 191 Hz to 100 kHz

Output method

00: No counting	CW
01: No counting	CCW
10: Incremental counting	CW
12: Incremental counting	Direction output off
13: Incremental counting	Direction output on
21: Decremental counting	CCW
22: Decremental counting	Direction output off
23: Decremental counting	Direction output on

(*2): Frequency (Hz) K constant

1.5 Hz to 9.8 KHz [K1 to K9800 (unit: Hz)] (max. error near 9.8 kHz approx. –0.9 kHz)
* Set K1 to specify 1.5 Hz.
48 Hz to 100 KHz [K48 to K100000 (unit: Hz)] (max. error near 100 kHz approx. –3 kHz)
191 Hz to 100 KHz [K191 to K100000 (unit: Hz)] (max. error near 100 kHz approx. –0.8 kHz)
Specify the initial frequency to 30 kHz or less.

(*3): Target value (absolute value) (can only be specified for ver. 2.0 or higher)
Designate the target value setting in the range indicated below. If an out of range value is designated, the number of pulses output will be different than the designated value. The target value setting is ignored in the no count mode (0 = “Mode with no target value”).

Output method	Range of target values which can be designated
Incremental counting	Designate a value larger than the current value.
Decremental counting	Designate a value smaller than the current value.

Target value setting

The FPΣ supports two operation modes for jogging operation, one in which no target value is specified, and one in which feed stops when the target value is reached.

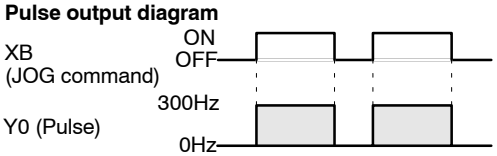
Normal jogging operation feed (no target value specified)

Pulses are output in accordance with the conditions set in the data table, as long as the execution condition is on.

Data table

DT300 DT301	Control code	: H1110
DT302 DT303	Frequency	: 300 Hz

Pulse output diagram



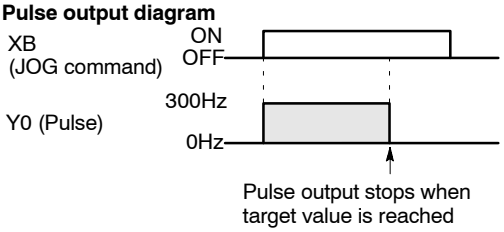
Output stops when target value is reached (only version 2.0 or higher)

With version 2.0 and higher of the FPΣ (control unit C32T2), a target value at which pulse output stops can be specified for jogging operation. As shown below, this mode is selected in the control code, and the target value (an absolute value) is specified in the data table.

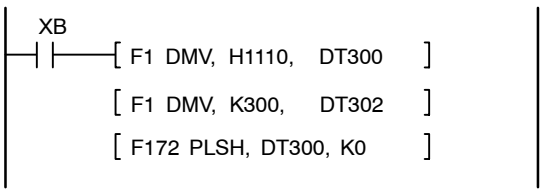
Data table

DT300 DT301	Control code	: H11110
DT302 DT303	Frequency	: 300 Hz
DT304 DT305	Target value	: K1000

Pulse output diagram



FPWIN GR:



FPWIN Pro:

DUT

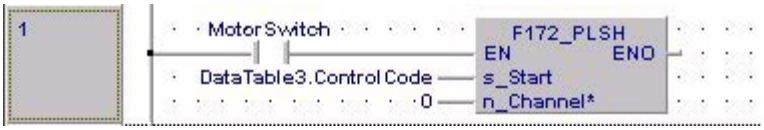
MotorDataJog [DUT]

	Identifier	Type	Initial	Comment
0	Control Code	DWORD	0	Highest WORD fixed to 0000 Lowest WORD = Control Code
1	Frequency	DINT	0	Frequency (Hz)

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	MotorSwitch	BOOL	FALSE	
1	VAR	DataTable3	MotorDataJog	Control Code := 16#1110, Frequency := 300	Control Code 16#1110= 1 = 25% duty 1= 48 to 100 kHz 10 = incremental counting CW Frequency = 300 Hz

LD Body



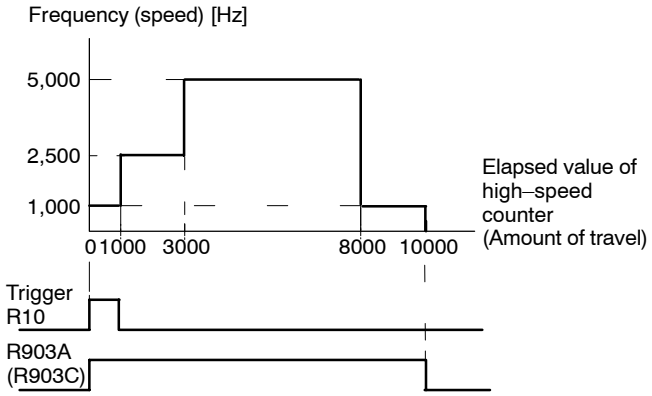
7.4.4.4 Positioning Control Instruction F174 – Data Table Control

Positioning is performed according to the specified data table.

Example:

When the execution condition R10 is on, pulses are output from Y0 at a frequency of 1,000 Hz, and positioning begins. When 1,000 pulses have been counted, the frequency changes to 2,500 Hz. Positioning is then carried out according to the values of the data table. Positioning stops when the pulse output stop value (K0) is reached.

Pulse output diagram

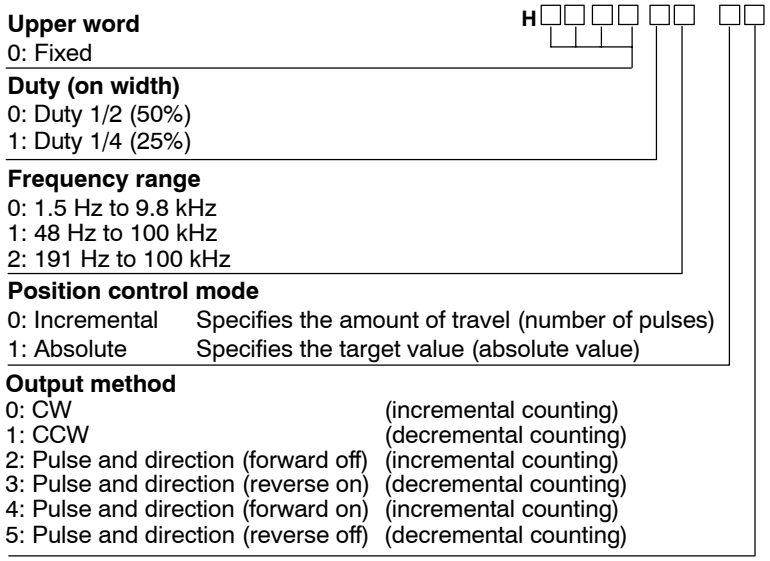


When the execution condition (trigger) R10 of the **F174 (SP0H)** instruction is on, the high–speed counter control flag R903A (R903C) goes on. When the elapsed value reaches 10,000 and pulse output stops, R903A (R903C) goes off.

Positioning data table

DT400 DT401	Control code *1	:H 1200
DT402 DT403	Frequency 1 *2	:1000 Hz
DT404 DT405	Target value 1 *3	:1000 pulses
DT406 DT407	Frequency 2	:2500 Hz
DT408 DT409	Target value 2	:2000 pulses
DT410 DT411	Frequency 3	:5000 Hz
DT412 DT413	Target value 3	:5000 pulses
DT414 DT415	Frequency 4	:1000 Hz
DT416 DT417	Target value 4	:2000 pulses
DT418 DT419	Pulse output stop setting	:K0

(*1): Control code (H constant)


H
Upper word
0: Fixed
Duty (on width)
0: Duty 1/2 (50%)
1: Duty 1/4 (25%)
Frequency range
0: 1.5 Hz to 9.8 kHz
1: 48 Hz to 100 kHz
2: 191 Hz to 100 kHz
Position control mode
0: Incremental Specifies the amount of travel (number of pulses)
1: Absolute Specifies the target value (absolute value)
Output method
0: CW (incremental counting)
1: CCW (decremental counting)
2: Pulse and direction (forward off) (incremental counting)
3: Pulse and direction (reverse on) (decremental counting)
4: Pulse and direction (forward on) (incremental counting)
5: Pulse and direction (reverse off) (decremental counting)

(*2): Frequency (Hz) K constant

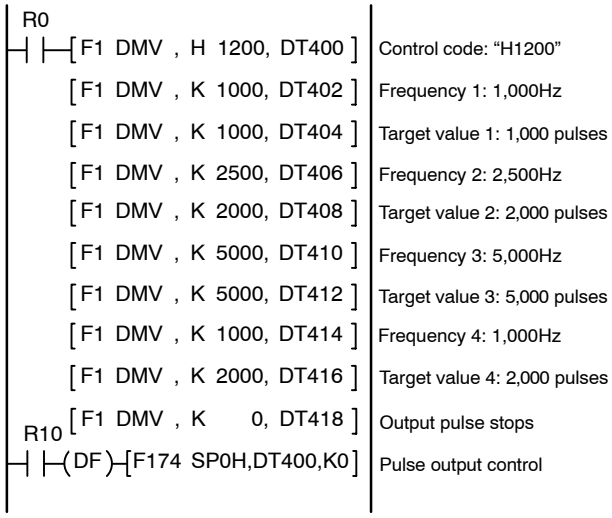
1.5 Hz to 9.8 kHz [K1 to K9800 (unit: Hz)] (max. error near 9.8 kHz: approx. −0.9 kHz)
* Set 1 to specify 1.5 Hz.
48 Hz to 100 kHz [K48 to K100000 (unit: Hz)] (max. error near 100 kHz: approx. −3 kHz)
191 Hz to 100 kHz [K191 to K100000 (unit: Hz)] (max. error near 100 kHz: approx. −0.8 kHz)
Specify the initial frequency to 30 kHz or less.

(*3): Target value (K–2147483648 to K2147483647)

The value of the 32−bit data specified for the target value should be within the range indicated in the table below.

Specification of control code		Range of permissible target values
Position control mode	**Output method**	
Incremental	**Incremental counting**	Specifies a positive value.
	Decremental counting	Specifies a negative value.
Absolute	**Incremental counting**	Specifies a value larger than the current value
	Decremental counting	Specifies a value smaller than the current value

FPWIN GR:


R0
F1 DMV , H 1200, DT400
Control code: “H1200”
F1 DMV , K 1000, DT402
Frequency 1: 1,000Hz
F1 DMV , K 1000, DT404
Target value 1: 1,000 pulses
F1 DMV , K 2500, DT406
Frequency 2: 2,500Hz
F1 DMV , K 2000, DT408
Target value 2: 2,000 pulses
F1 DMV , K 5000, DT410
Frequency 3: 5,000Hz
F1 DMV , K 5000, DT412
Target value 3: 5,000 pulses
F1 DMV , K 1000, DT414
Frequency 4: 1,000Hz
F1 DMV , K 2000, DT416
Target value 4: 2,000 pulses
F1 DMV , K 0, DT418
Output pulse stops
R10
DF
F174 SP0H,DT400,K0
Pulse output control

FPWIN Pro:

DUT

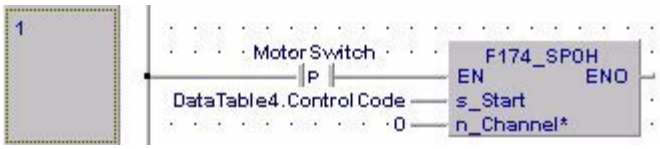
F174_DUT [DUT]

	Identifier	Type	Initial	Comment
0	Control Code	DWORD	0	Highest word fixed to 0
1	Frequency1	DINT	0	
2	TargetValue1	DINT	0	
3	Frequency2	DINT	0	
4	TargetValue2	DINT	0	
5	Frequency3	DINT	0	
6	TargetValue3	DINT	0	
7	Frequency4	DINT	0	
8	TargetValue4	DINT	0	
9	Termination	DINT	0	End of data table

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	MotorSwitch	BOOL	FALSE	
-	VAR	DataTable4	F174_DUT	Control Code := 1200, Frequency1 := 1000, TargetValue1 := 1000, Frequency2 := 2500, TargetValue2 := 2000, Frequency3 := 5000, TargetValue3 := 5000, Frequency4 := 1000, TargetValue4 := 2000, Termination := 0	For Control Code (16#1200): 1 = 25% duty 2 = 191 Hz to 100 kHz 0 = Incremental position control 0 = CW (incremental counting)
1					

LD Body



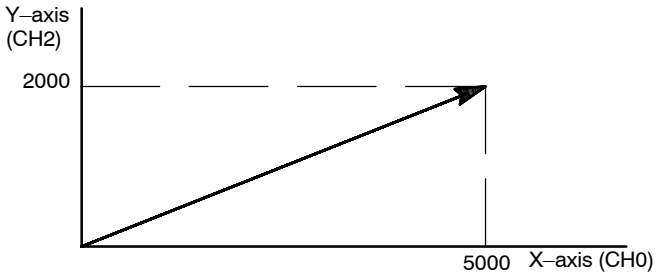
7.4.4.5 Pulse Output Instruction F175 – Linear Interpolation

The linear interpolation controls positioning with two axes according to the specified data table.

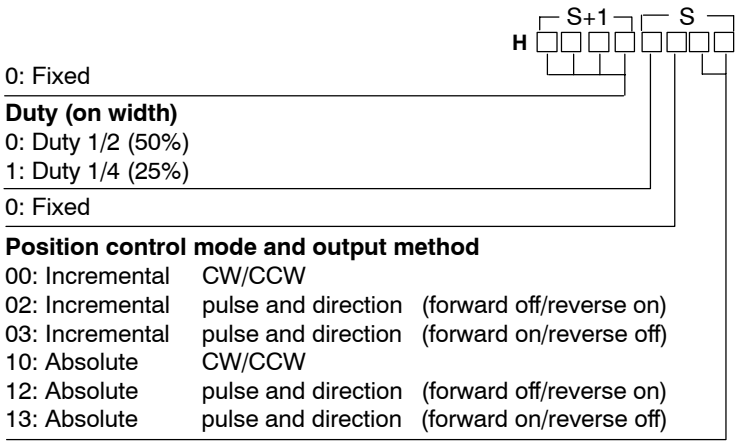
Positioning data table

DT500 DT501	Control code	(*1)	**Setting area** Designated with user program
DT502 DT503	Composite speed (Initial speed) [Hz]	(*2)	
DT504 DT505	Composite speed (Maximum speed) [Hz]	(*2)	
DT506 DT507	Acceleration/Deceleration time [ms]	(*3)	
DT508 DT509	Target value (X–axis) (CH0) [pulses]	(*4)	
DT510 DT511	Target value (Y–axis) (CH2) [pulses]	(*4)	
DT512 DT513	X–axis (CH0) component speed (Initial speed)	(*5)	**Operation result storage area** Parameters for each axis component, calculated due to instruction execution, are stored here.
DT514 DT515	X–axis (CH0) component speed (Maximum speed)		
DT516 DT517	Y–axis (CH2) component speed (Initial speed)		
DT518 DT519	Y–axis (CH2) component speed (Maximum speed)		
DT520	X–axis (CH0) frequency range	(*6)	
DT521	Y–axis (CH2) frequency range		
DT522	X–axis (CH0) number of acceleration/deceleration steps	(*7)	
DT523	Y–axis (CH2) number of acceleration/deceleration steps	(*7)	

Positioning path



(*1): Control code (H constant)


S+1
S
H
0: Fixed
Duty (on width)
0: Duty 1/2 (50%)
1: Duty 1/4 (25%)
0: Fixed
Position control mode and output method
00: Incremental CW/CCW
02: Incremental pulse and direction (forward off/reverse on)
03: Incremental pulse and direction (forward on/reverse off)
10: Absolute CW/CCW
12: Absolute pulse and direction (forward off/reverse on)
13: Absolute pulse and direction (forward on/reverse off)

(*2): Composite speed (initial speed, maximum speed) (Hz) <K constant>

1.5Hz to 100kHz [K1 to K100000]

1.5Hz is for an angle of 0deg or 90deg only.

For 1.5 Hz specify K1.

If the component speed drops lower than the minimum speed for each frequency range, then the speed will become the corrected component speed, so be careful. (See *6)

When simultaneously using a high–speed counter, periodical interrupt or PLC link, do not set to 60kHz or higher.

If the initial speed is set equal to the maximum speed, pulses will be output with no acceleration/deceleration.

Set the composite speed so that component speed of each axis is 1.5 Hz or greater.

Specify the initial frequency to 30 kHz or less.

(*3): Acceleration/deceleration time (ms) "K constant"

K0 to K32767

If this is 0, pulses will be output for the initial speed (composite speed) as is, with no acceleration/deceleration.

(*4): Target value

K–8388608 to K8388607

When operating only one axis:

a) In incremental position control mode, set the target value for the axis which will not be operated to 0.

b) In absolute position control mode, set the target value for the axis which will not be operated the same as the current value.

(*5): Component speed (initial speed and maximum speed of each axis)

This is stored as 2 words in real numbers type.

$$\text{X–axis component speed} = \frac{\text{(Composite speed) x (X–axis movement distance)}}{\sqrt{\text{((X–axis movement distance)}^2 + \text{(Y–axis movement distance)}^2)}}$$

$$\text{Y–axis component speed} = \frac{\text{(Composite speed) x (Y–axis movement distance)}}{\sqrt{\text{((X–axis movement distance)}^2 + \text{(Y–axis movement distance)}^2)}}$$

Example:

Even if the initial speed is corrected (See *6), the calculation value will be stored as is in the operation result storage area.

(*6): Frequency range

The system automatically selects the frequency range for each component of each axis.

Range 0: 1.5Hz to 9.8kHz

Range 1: 48Hz to 100kHz

Range 2: 191Hz to 100kHz

a) Maximum speed ≦ 9800Hz:

If initial speed < 1.5Hz, initial speed is corrected to 1.5Hz, and range 0 is selected.
If initial speed ≧ 1.5Hz, range 0 is selected.

b) 9800Hz < maximum speed ≦ 100000Hz:
If initial speed < 48Hz, initial speed is corrected to 48Hz, and range 0 is selected.
If 48Hz ≦ initial speed < 191Hz, range 1 is selected.
If initial speed ≧ 191Hz, range 2 is selected.

(*7): Number of acceleration/deceleration steps

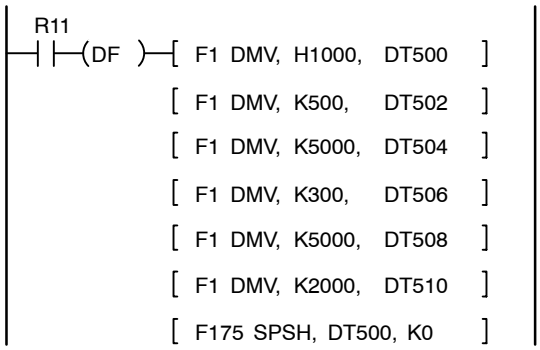
The system automatically calculates the number of acceleration/deceleration steps in the range 0 to 60 steps.
If the operation result is 0, pulses are output for the initial speed (composite speed) as is, with no acceleration/deceleration.
The number of acceleration/deceleration steps is found using the following formula:
acceleration/deceleration time (ms) x component initial speed (Hz).
Example:
With incremental position control mode, initial speed 300Hz, maximum speed 5kHz, acceleration/deceleration time 0.5s, CH0 target value 1000, CH2 target value 50

$$\text{CH0 component initial speed} = \frac{300 \times 1000}{\sqrt{(1000^2 + 50^2)}} = 299.626\text{Hz}$$

$$\text{CH2 component initial speed} = \frac{300 \times 50}{\sqrt{(1000^2 + 50^2)}} = 14.981\text{Hz}$$

CH0 number of acceleration/deceleration steps = $500 \times 10^{-3} \times 299.626 = 147.8 \Rightarrow 60$ steps
CH2 number of acceleration/deceleration steps = $500 \times 10^{-3} \times 14.981 = 7.4 \Rightarrow 7$ steps

FPWIN GR:



FPWIN Pro:

DUT

The following DUT is predefined in the “Matsushita Lib” library.

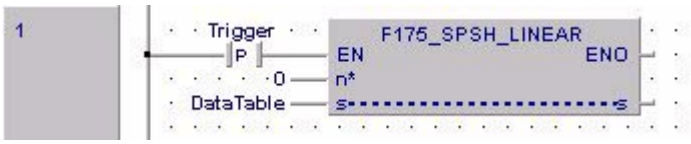
PULSE_LINEAR [DUT]

	Identifier	Type	Initia	Comment
0	Control Code	DWORD	0	IN: Control code Bit 12 Duty: FALSE=25%, TRUE=50% Bit 4: FALSE=Incremental, TRUE=Absolut Bits 0,1: 0=CW/CCW, 2=PLS+SIGN(forward OFF), 3=PLS+SIGN(forward ON
1	Initial Speed	DINT	0	IN: Composite speed initial Fmin (Hz) [1.5Hz to 100kHz]
2	Maximum Speed	DINT	0	IN: Composite speed maximum Fmax (Hz) [1.5Hz to 100kHz]
3	Accel Decel Time	DINT	0	IN: Acceleration/deceleration time T (ms) [0ms to 32767ms]
4	TargetValue_X	DINT	0	IN: X-axis (CH0) target value (movement distance) [-8388608 to 8388607]
5	TargetValue_Y	DINT	0	IN: Y-axis (CH2) target value (movement distance) [-8388608 to 8388607]
6	Initial Speed_X	REAL	0	OUT: X-axis (CH0) component speed initial Fmin (Hz)
7	Maximum Speed_X	REAL	0	OUT: X-axis (CH0) component speed maximum Fmax (Hz)
8	Initial Speed_Y	REAL	0	OUT: Y-axis (CH2) component speed initial Fmin (Hz)
9	Maximum Speed_Y	REAL	0	OUT: Y-axis (CH2) component speed maximum Fmax (Hz)
10	FreqRange_X	INT	0	OUT: X-axis (CH0) frequency range [0,1,2]
11	FreqRange_Y	INT	0	OUT: Y-axis (CH2) frequency range [0,1,2]
12	Accel Decel Steps X	INT	0	OUT: X-axis (CH0) acceleration/deceleration steps [0 to 60]
13	Accel Decel Steps Y	INT	0	OUT: Y-axis (CH2) acceleration/deceleration steps [0 to 60]

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Trigger	BOOL	FALSE	
1	VAR	DataTable	PULSE_LINEAR	Control Code := 1000, Initial Speed := 500, Maximum Speed := 5000, Accel Decel Time := 300, TargetValue_X := 5000, TargetValue_Y := 2000	Control code: 1 = Duty 25 % 0 = Fixed 00 = Incremental CW/C

LD Body



7.4.4.6 Pulse Output Instruction F176 – Circular Interpolation

The circular interpolation controls positioning with two axes according to the specified data table.

Position of specification method

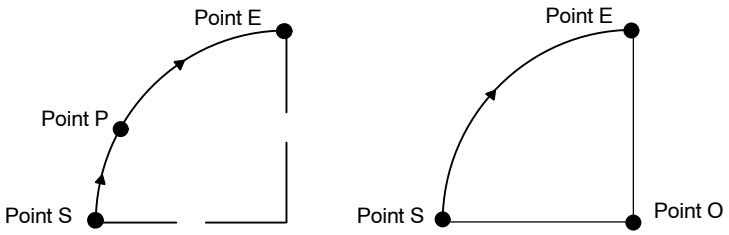
–For the FPΣ designate the position using one of the following methods.

Specification of passing position

–Designate the two points, the target position E and the passing position S, for the current position P.

Specification of center position

–Designate target position E and center position Q of the circle to be drawn, for the current position P.



Stop mode and continue mode

Stop mode

–This mode stops the action at the target position set by execution of the circular interpolation instruction.

–Designate this mode when the position specification for circular interpolation control is one set.

–Designate this mode after circular interpolation control when stopping or entering the next control such as linear interpolation control.

Continue mode

–During circular interpolation instruction execution and before reaching the set target value, this mode causes the circular interpolation action to continue when the next target position is set.

–Designate this mode when you want to perform the circular interpolation action continuously.

Specification of rotation direction

–Designate the rotation direction with a control code in a user program.

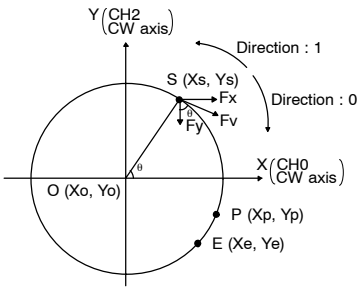
–Verify the axial positional relationship and the relationship with the rotation direction that will be actually used.

Specification of rotation direction

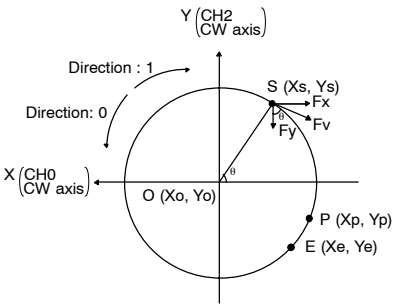
–From CH0–CW axis to CH2–CW direction: control code rotation direction specification is 1.

–From CH2–CW axis to CH0–CW direction: control code rotation direction specification is 0.

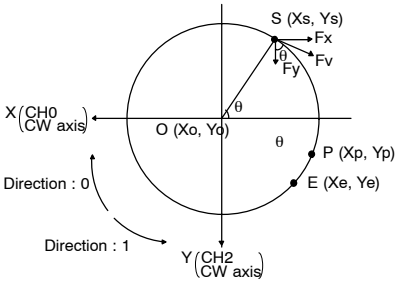
Example: a



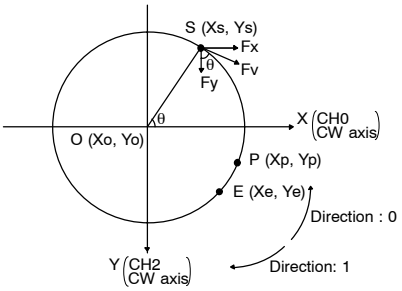
Example: b



Example: c



Example: d



Key Point:

–Specification of the rotation direction changes in accordance with the axial direction and the CW/CCW direction.

Action of the flag concerning circular interpolation

Table of flag Allocation

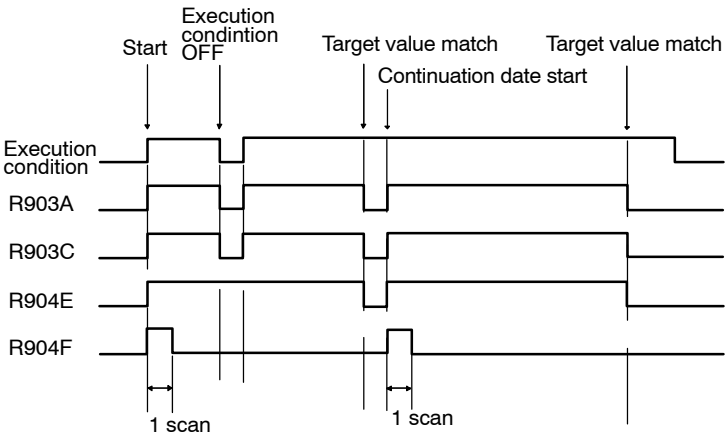
Address	Flag conditions	The uses of flag in the program
R903A Control flag (CH1)	–Turns on during execution of pulse output instructions that include a circular interpolation instruction and then maintains that state during pulse output from CH0. This flag is the same for instructions F166 to F176.	–Use this to prohibit the simultaneous execution of other high–speed counter instructions and pulse output instructions, and to verify completion of an action.
R903C Control flag (CH2)	–Turns on during execution of pulse output instructions that include a circular interpolation instruction and then maintains that state during pulse output from CH0. This flag is the same for instructions F166 to F176.	–Use this to prohibit the simultaneous execution of other high–speed counter instructions and pulse output instructions, and to verify completion of an action.
R904E Control flag for circular interpolation	–Turns ON when circular interpolation instruction F176 starts up and maintains that state until the target value is reached. When the target value has not been reached even if the circular interpolation instruction execution condition is OFF, that state is maintained.	–Use this to prohibit the simultaneous execution of other high–speed counter instructions and to verify completion of a circular interpolation action. When this flag is on other positioning instructions F171 to F176 cannot be started.
R904F Set value change confirmation	–This turns on when the circular interpolation instruction F176 starts up and this state is maintained of the next circular interpolation instruction F176 execution.	When conducting control with the continuous mode for performing continuous circular interpolation actions, use this after circular interpolation instruction startup when overwriting the next target value.

Notes

- **When the target value has not been reached and the execution condition is off, circular interpolation control flag R904E turns on and other positioning instructions F171 to F176 cannot start up.**
- **The circular interpolation target value overwrite permission flag R904F turns off after instruction execution when the next instruction executes. Also, it turns off during execution in an interrupt program.**

Flag movement when command running

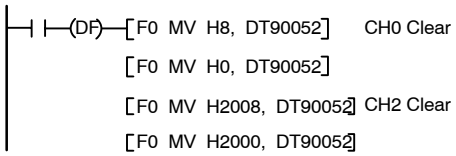
Action when the execution conditions turns OFF



–Differing from other pulse output instructions, circular interpolation instruction F176 executes the execution conditions as continually ON.
–Circular interpolation instruction F176 stops pulse output when the execution conditions turn OFF.

Notes

- **Right when the execution condition turn off, positioning instructions F171 to F176, other than the currently running instruction F176, cannot be started up when the target value has not been reached.**
- **When restarting, use pulse output control instruction F0, below, to reset the pulse output instruction. This operation resets the Control flag for circular interpolation (R904E).**



To reset control flags using FPWIN Pro, refer to the programming example in section 7.4.6.1, for instance.

About composite speed setting

–The maximum composite speed setting is 20 kHz.
–Use the range of the formula given below as a guide when setting the composite speed.

$$Fv\ (Hz) \leqq r\ (pulse) \times 10 / t\ (ms)$$

Fv : Composite speed (Hz)
R : Radius (pulse)
t : Scan time (ms)

Example: Radius r: 1000 (pulse), Scan time 5ms
$Fv \leqq 1000(p) \times 10 / 5\ (ms) = 2000Hz$

Note

–Accuracy may be degraded if the scan time exceeds 10 ms. If this should happen, execute circular interpolation instruction F176 using the periodical interrupt function with an interrupt time of around 0.5 ms.

Restrictions on positioning data setting

– Designate settings for the target position, pass position and stop position so they are within the following range.

– 8,388,608 to +8,388,607

– When using in combination with other positioning instructions like F171, designate so the target value is within the above range, even in those instructions.

Positioning data table

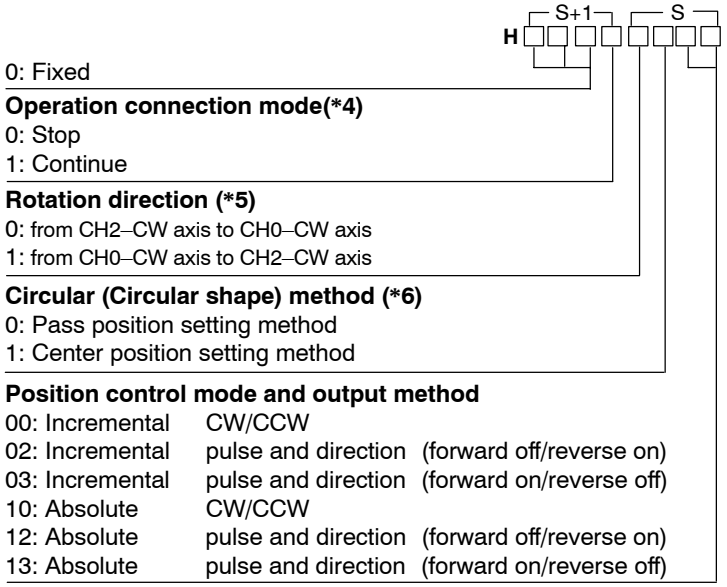
Pass position setting method

DT600 DT601	Control code	(*1)	**Setting area** Designated with user program
DT602 DT603	Composite speed [Hz]	(*2)	
DT604 DT605	Target value (X–axis) (CH0) [pulses]	(*3)	
DT606 DT607	Target value (Y–axis) (CH2) [pulses]		
DT608 DT609	Pass value (X–axis) (CH0) [pulses]		
DT610 DT611	Pass value (Y–axis) (CH2) [pulses]		
DT612 DT613	Radius [pulses]		**Operation result storage area** Parameters for each axis component, calculated due to instruction execution, are stored here.
DT614 DT615	Center position (X–axis) (CH0) [pulses]		
DT616 DT617	Center position (Y–axis) (CH2) [pulses]		

Center position setting method

DT600 DT601	Control code	(*1)	**Setting area**
DT602 DT603	Composite speed [Hz]	(*2)	
DT604 DT605	Target value (X–axis) (CH0) [pulses]	(*3)	
DT606 DT607	Target value (Y–axis) (CH2) [pulses]	(*3)	
DT608 DT609	Center position (X–axis) (CH0) [pulses]		
DT610 DT611	Center position (Y–axis) (CH2) [pulses]		
DT612 DT613	Radius [pulses]		**Operation result storage area**

(*1): Control code (H constant)


S+1
S
H
0: Fixed
Operation connection mode(*4)
0: Stop
1: Continue
Rotation direction (*5)
0: from CH2–CW axis to CH0–CW axis
1: from CH0–CW axis to CH2–CW axis
Circular (Circular shape) method (*6)
0: Pass position setting method
1: Center position setting method
Position control mode and output method
00: Incremental CW/CCW
02: Incremental pulse and direction (forward off/reverse on)
03: Incremental pulse and direction (forward on/reverse off)
10: Absolute CW/CCW
12: Absolute pulse and direction (forward off/reverse on)
13: Absolute pulse and direction (forward on/reverse off)

(*2): Composite speed (frequency) "K constant"
100 Hz to 20 kHz [K100 to K20000]
As a guide, keep the composite speed within the range of the formula below.
Fv[Hz] <= radius[pulse] x 10/scantime[ms]

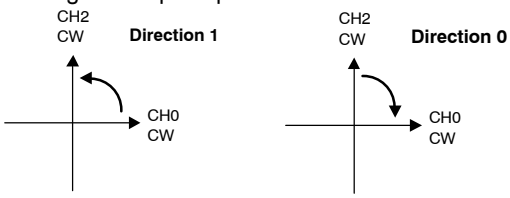
(*3): Target position and pass position
K–8388608 to K8388607

(*4): Operation connection mode
Stop:
When stop (0) is specified, it will stop when the target position is reached.
Continue:
When the following circular interpolation data table is overwritten when continue (1) is specified after circular interpolation action begins, the following circular interpolation begins when the first

circular interpolation that was started up finishes (target position reached). To finish, specify stop (0) for this flag (operation connection mode) after the last circular interpolation action has started.

(*5): Rotation direction

Pulses are output according to the designated direction. Operation differs, as indicated below, depending on the pass position and rotation direction setting.



(*6): Circular (Circular shape) method

Pass position setting method:

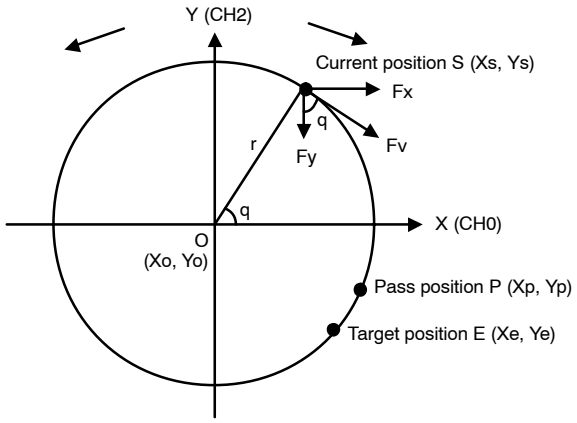
The center position and the radius of the arc are calculated by specifying the pass and target positions for the current position.

Center position setting method:

The radius of the circle is calculated by specifying the center and target positions for the current position.

Positioning path

Direction 1 Direction 0



Let CH0 be the X–axis, and CH2 be the Y–axis.

O (Xo, Yo): Center point (Center position)
S (Xs, Ys): Start point (Current position)
P (Xp, Yp): Pass point (Pass position)
E (Xe, Ye): End point (Target position)

$$Fx = Fv \sin q = Fv \frac{|Ye - Yo|}{r} \qquad Fy = Fv \cos q = Fv \frac{|Xe - Xo|}{r}$$

FPWIN GR:

Pass position method

```
R12
─┤ ├─(DF )─[ F1 DMV, H10,      DT600 ]
         [ F1 DMV, K500,      DT602 ]
         [ F1 DMV, K8660,     DT604 ]
         [ F1 DMV, K–5000,    DT606 ]
         [ F1 DMV, K9396,     DT608 ]
         [ F1 DMV, K–3420,    DT610 ]
         [ F176 SPCH, DT600, K0     ]
```

Assume that the execution conditions for this instruction always hold.
When the execution conditions are off, pulse output stops.

FPWIN Pro:

Pass position method

DUT

The following DUT is predefined in the “Matsushita Lib” library.

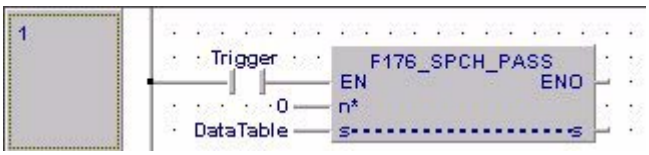
PULSE_ARC_PASS [DUT]

	Identifier	Type	Initial	Comment
0	Control Code	DWORD	16#00000000	IN: Control code Bit 16: FALSE=Stop, TRUE=Continue Bit 12: FALSE=CW (right), TRUE=CCW (left) Bit 8: FALSE=Pass, TRUE=Center Bit 4: FALSE=Incremental, TRUE=absolut Bits 0,1: 0=CW/CCW, 2=PLS+SIGN(forward OFF), 3=PLS+SIGN(forward ON
1	Speed	DINT	0	IN: Composite speed initial Fmin (Hz) [100Hz to 20kHz]
2	TargetPos_X	DINT	0	IN: X-axis (CH0) target position [-8388608 to 8388607]
3	TargetPos_Y	DINT	0	IN: Y-axis (CH2) target position [-8388608 to 8388607]
4	PassPos_X	DINT	0	IN: X-axis (CH0) pass position [-8388608 to 8388607]
5	PassPos_Y	DINT	0	IN: Y-axis (CH2) pass position [-8388608 to 8388607]
6	Radius	DINT	0	OUT: Radius
7	CenterPos_X	DINT	0	OUT: X-axis (CH0) center position
8	CenterPos_Y	DINT	0	OUT: Y-axis (CH2) center position

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Trigger	BOOL	FALSE	
1	VAR	DataTable	PULSE_ARC_PASS	Control Code := 16#10, Speed := 500, TargetPos_X := 8660, TargetPos_Y := -5000, PassPos_X := 9396, PassPos_Y := -3420	Control code: 0 = CW direction (right) 0 = pass position method 10 = absolute CW/CCW

LD Body



Center position method

DUT

The following DUT is predefined in the “Matsushita Lib” library.

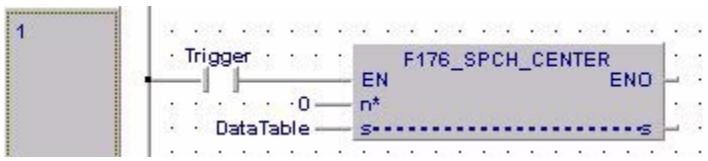
PULSE_ARC_CENTER [DUT]

	Identifier	Type	Initial	Comment
0	Control Code	DWORD	16#00000100	IN: Control mode Bit 16: FALSE=Stop, TRUE=Continue Bit 12: FALSE=CW (right), TRUE=CCW (left) Bit 8: FALSE=Pass, TRUE=Center Bit 4: FALSE=Incremental, TRUE=absolut Bits 0,1: 0=CW/CCW, 2=PLS+SIGN(forward OFF), 3=PLS+SIGN(forward ON)
1	Speed	DINT	0	IN: Composite speed initial Fmin (Hz) [100Hz to 20kHz]
2	TargetPos_X	DINT	0	IN: X-axis (CH0) target position [-8388608 to 8388607]
3	TargetPos_Y	DINT	0	IN: Y-axis (CH2) target position [-8388608 to 8388607]

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Trigger	BOOL	FALSE	
1	VAR	DataTable	PULSE_ARC_CENTER	Control Code := 16#110, Speed := 2000, TargetPos_X := 8660, TargetPos_Y := -5000	Control code: 0 = CW direction (right) 1 = center position method 10 = absolute CW/CCW

LD Body



7.4.4.7 Pulse Output Control Instruction F0

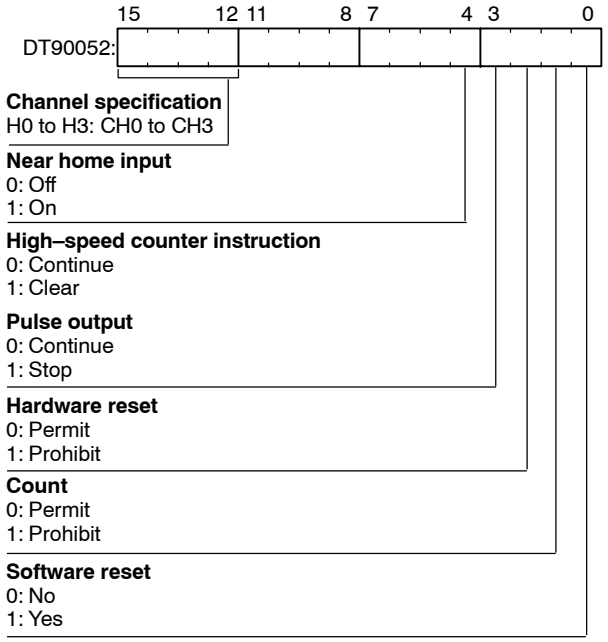
This instruction is used for resetting the built–in high–speed counter, stopping the pulse output, and setting and resetting the near home input.

Specify this **F0 (MV)** instruction together with special data register DT90052.

Once this instruction is executed, the settings will remain until this instruction is executed again.

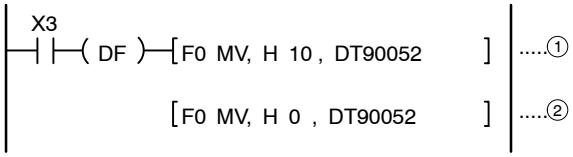
High–speed counter control flag area of FPΣ

The area DT90052 for writing channels and control codes is allocated as shown below. Control codes written with an **F0(MV)** instruction are stored by channel in special data registers DT90190 to DT90193.



Programming example 1: Enable the near home input during home return operations and begin deceleration.

FPWIN GR:



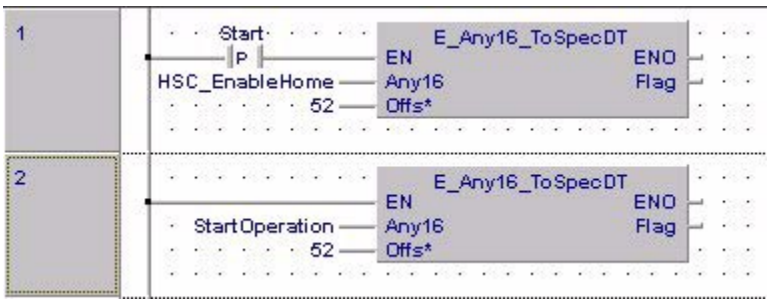
In the program, the near home input is enabled in step ① and 0 is entered just after that in step ② to perform the preset operations.

FPWIN Pro:

POU Header

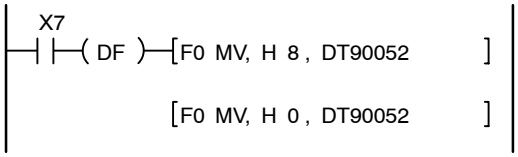
	Class	Identifier	Type	Initial	Comment
0	VAR	Start	BOOL	FALSE	
1	VAR	HSC_EnableHome	WORD	16#10	Enables near home input
2	VAR	StartOperation	WORD	0	Starts preset operation

LD Body



Programming example 2: Performing a forced stop of the pulse output

FPWIN GR:

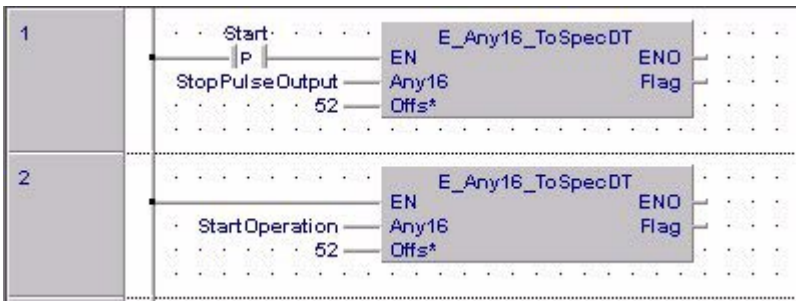


FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Start	BOOL	FALSE	
1	VAR	StopPulseOutput	WORD	16#8	Performs a forced stop of the pulse output
2	VAR	StartOperation	WORD	0	Starts preset operation

LD Body

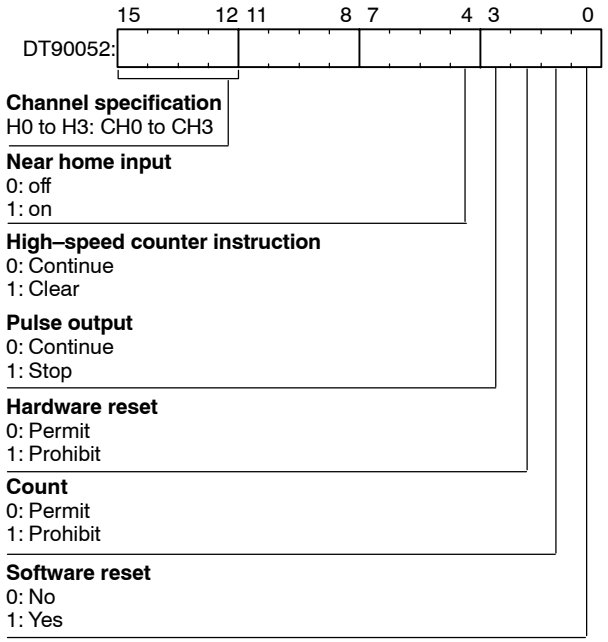


7.4.4.8 Elapsed Value Write and Read Instruction F1

This instruction is used to read the pulse number counted by the built–in high–speed counter.
Specify this **F1 (DMV)** instruction together with the special data register DT90044.
The elapsed value is stored as 32–bit data in the combined area of special data registers DT90044 and DT90045.
Use only this **F1 (DMV)** instruction to set the elapsed value.

High–speed counter control flag area of FPΣ

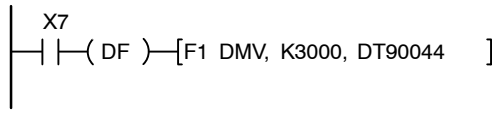
The area DT90052 for writing channels and control codes is allocated as shown below. Control codes written with an **F0(MV)** instruction are stored by channel in special data registers DT90190 to DT90193.



For information on the special data register for the high–speed counter function and the pulse output function, see pages 7-4 and 7-5.

Programming example 1: Writing the elapsed value

FPWIN GR:



Set the initial value of K3000 in the high–speed counter.

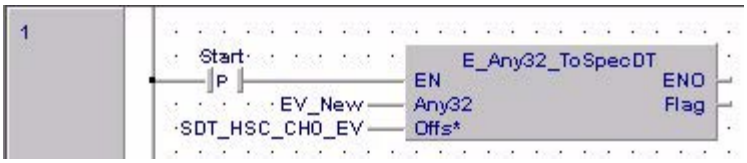
FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Start	BOOL	FALSE	Activates the function
1	VAR	EV_New	DINT	3000	Initial value of HSC
2	VAR_CONSTANT	SDT_HSC_CH0_EV	INT	44	Offset to DDT90044

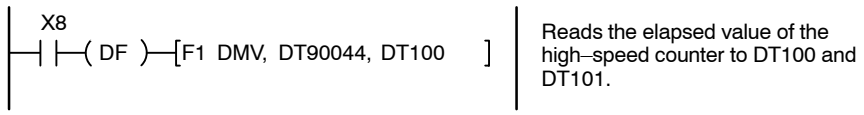
LD Body

The E_Any32_ToSpecDT instruction (NC Tool Library) copies PLC–independent data from the 32–bit variable at input Any32 to the special data register defined by the value at input Offs*. The variable input Any32 is thus copied to the data register DDT(9000+Offs) or DDT(90000+Offs). The output flag is not used.



Programming example 2: Reading the elapsed value

FPWIN GR:



FPWIN Pro:

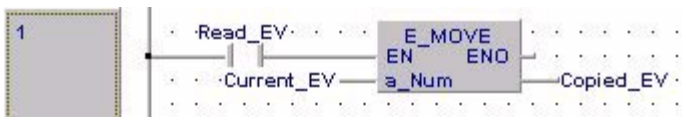
GVL

	Class	Identifier	Matsushit	IEC_Address	Type	Initial	Au	Comment
0	VAR_GLOBAL	Current_EV	DDT90044	%MD5.90044	DINT	0		Address of elapsed value

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	Current_EV	DINT	0	Address of elapsed value
1	VAR	Read_EV	BOOL	FALSE	Reads elapsed value
2	VAR	Copied_EV	DINT	0	Outputs elapsed value

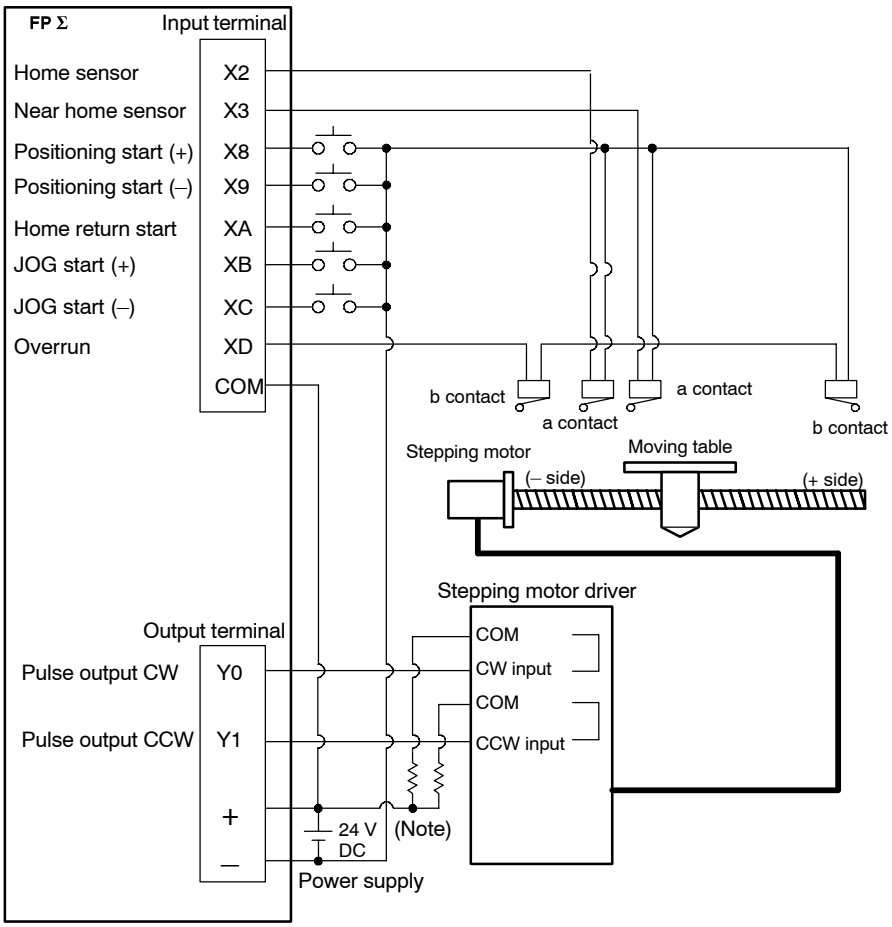
LD Body



Alternatively to the E_MOVE command, the commands E_SpecDT_ToAny32 or F1_DMV can be used.

7.4.5 Sample Programs

The wiring diagram below applies to all programs in this section.



Note

When the stepping motor input is a 5 V optical coupler type, connect a 2 kΩ 1/4 W resistor.

Note

The tables on this page apply to all programs in this section!

FPWIN GR:

Table of I/O allocation

I/O No.	Description	I/O No.	Description
X2	Home sensor input	**XD**	Overrunning signal
X3	Near home sensor input	**Y0**	Pulse output CW
X8	Positioning start signal (+)	**Y1**	Pulse output CCW
X9	Positioning start signal (–)	**R10**	Positioning in progress
XA	Home return start signal	**R11**	Positioning operation start
XB	JOG start signal (+)	**R12**	Positioning done pulse
XC	JOG start signal (–)	**R903A**	High–speed counter control flag for CH0

FPWIN Pro:

GVL

	Class	Identifier	Matsus	IEC_Addr	Type	Initial	Au	Comment
0	VAR_GLOBAL	HomeSensorInput	X2	%IX0.2	BOOL	FALSE		Home sensor input
1	VAR_GLOBAL	PulseOutCW	Y0	%QX0.0	BOOL	FALSE		Pulse output CW
2	VAR_GLOBAL	PulseOutCCW	Y1	%QX0.1	BOOL	FALSE		Pulse output CCW
3	VAR_GLOBAL	NearHomeSensorIn	X3	%IX0.3	BOOL	FALSE		Near home sensor input
4	VAR_GLOBAL	PosStartPlus	X8	%IX0.8	BOOL	FALSE		Positioning start signal (+)
5	VAR_GLOBAL	PosStartMinus	X9	%IX0.9	BOOL	FALSE		Positioning start signal (-)
6	VAR_GLOBAL	HomeReturnStart	XA	%IX0.10	BOOL	FALSE		Home return start signal
7	VAR_GLOBAL	JOGStartPlus	XB	%IX0.11	BOOL	FALSE		JOG start signal (+)
8	VAR_GLOBAL	JOGStartMinus	XC	%IX0.12	BOOL	FALSE		JOG start signal (-)
9	VAR_GLOBAL	OverrunSignal	XD	%IX0.13	BOOL	FALSE		Overrunning signal
10	VAR_GLOBAL	HSC_CH0_Flag	R903A	%MX0.903	BOOL	FALSE		High-speed counter control flag for CH0

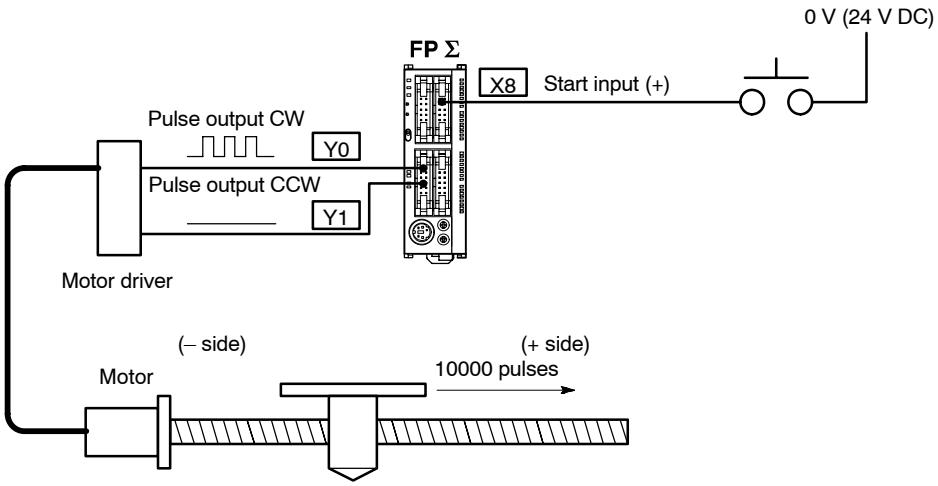
DUT

F171_DUT [DUT]

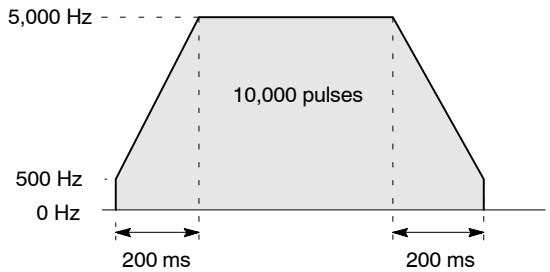
	Identifier	Type	Initia	Comment
0	Control Code	DWORD	0	Highest WORD fixed to 0000 Lowest WORD = Control code
1	Initial Speed	DINT	0	Initial speed (Hz)
2	Maximum Speed	DINT	0	Maximum speed (Hz)
3	Accel Time	DINT	0	Acceleration/deceleration time (ms)
4	Target Val	DINT	0	Target value, no. of pulses
5	Pulse Stop	DINT	0	End of data table

7.4.5.1 Incremental Position Control Operation: Plus Direction

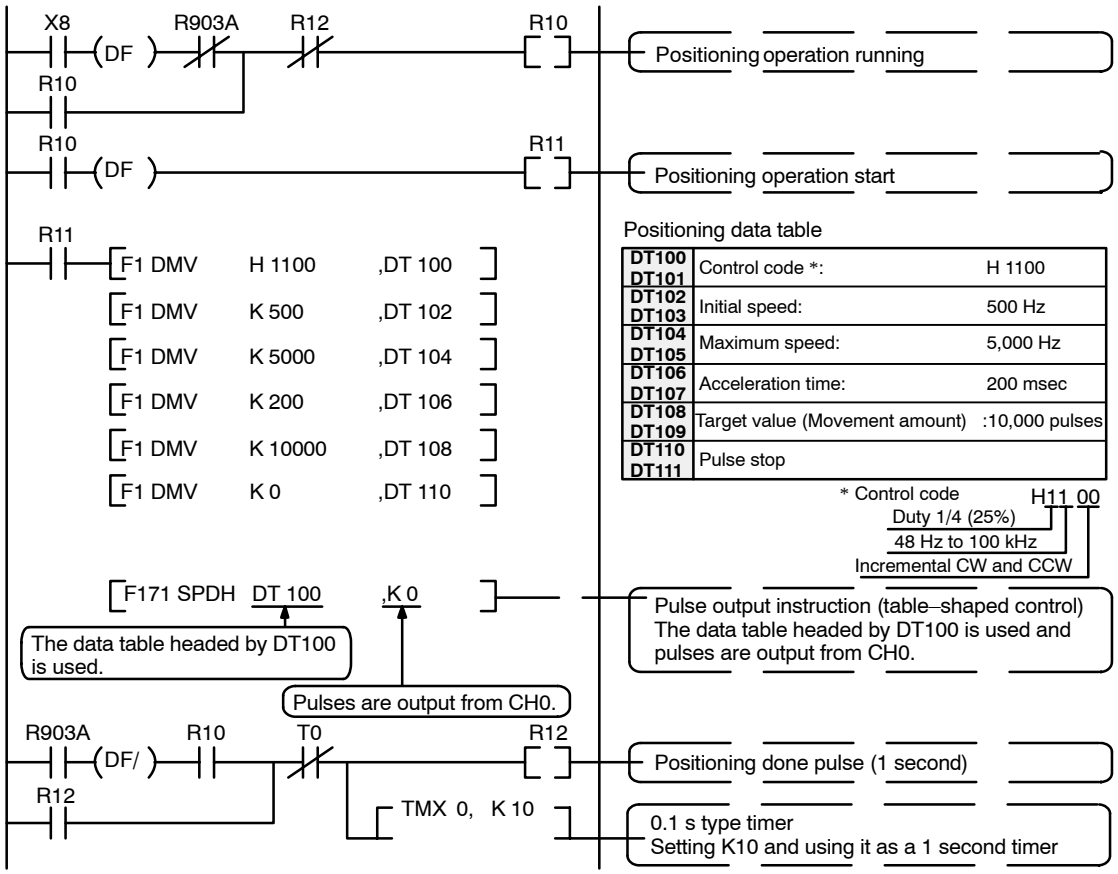
When X8 (PosStartPlus) turns on, the pulse is output from CW output Y0 (PulseOutCW) of the specified channel CH0. (Y0 is used implicitly by F171_SPDH.)



Pulse output diagram



FPWIN GR:


X8
DF
R903A
R12
R10
Positioning operation running
R10
R10
DF
R11
Positioning operation start
R11
F1 DMV H 1100 ,DT 100
F1 DMV K 500 ,DT 102
F1 DMV K 5000 ,DT 104
F1 DMV K 200 ,DT 106
F1 DMV K 10000 ,DT 108
F1 DMV K 0 ,DT 110
Positioning data table
DT100 DT101 Control code *: H 1100
DT102 DT103 Initial speed: 500 Hz
DT104 DT105 Maximum speed: 5,000 Hz
DT106 DT107 Acceleration time: 200 msec
DT108 DT109 Target value (Movement amount) :10,000 pulses
DT110 DT111 Pulse stop
* Control code H11 00
Duty 1/4 (25%)
48 Hz to 100 kHz
Incremental CW and CCW
F171 SPDH DT 100 ,K 0
Pulse output instruction (table–shaped control)
The data table headed by DT100 is used and pulses are output from CH0.
The data table headed by DT100 is used.
Pulses are output from CH0.
R903A
DF/
R10
T0
R12
Positioning done pulse (1 second)
R12
TMX 0, K 10
0.1 s type timer
Setting K10 and using it as a 1 second timer

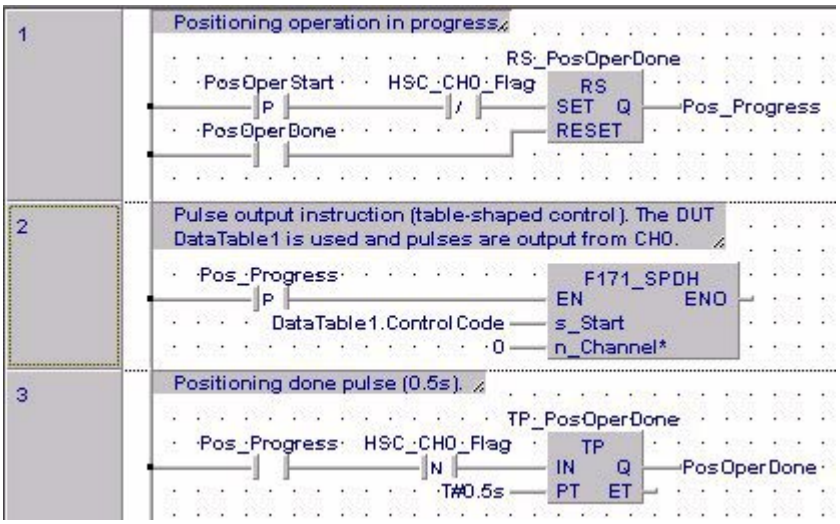
FPWIN Pro:

The GVL and DUT shown on page 7-62 apply to this program.

POU Header

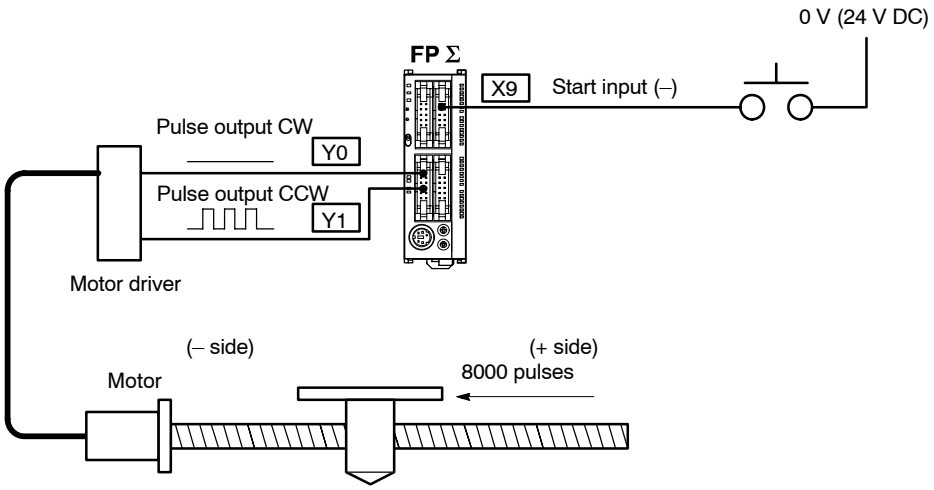
	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	PosStartPlus	BOOL	FALSE	Positioning start signal (+)
1	VAR_EXTERNAL	PulseOutCW	BOOL	FALSE	Pulse output CW
2	VAR_EXTERNAL	PulseOutCCW	BOOL	FALSE	Pulse output CCW
3	VAR_EXTERNAL	HSC_CH0_Flag	BOOL	FALSE	High-speed counter control flag for CH0
4	VAR	Pos_Progress	BOOL	FALSE	Positioning in progress
5	VAR	PosOperStart	BOOL	FALSE	Positioning operation start
6	VAR	PosOperDone	BOOL	FALSE	Positioning done pulse
7	VAR	DataTable1	F171_DUT	ControlCode := 16#1100, InitialSpeed := 500, MaximumSpeed := 5000, AccelTime := 200, TargetVal := 10000, PulseStop := 0	Control code 16#1100= 1 = 25% duty 1 = 48 Hz to 100 kHz 00 = Incremental CW/CCW
8	VAR	RS_PosOperDone	RS		
9	VAR	TP_PosOperDone	TP		

LD Body

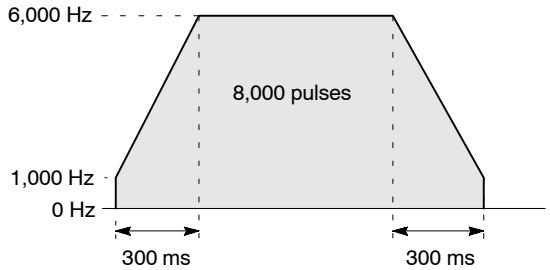


7.4.5.2 Incremental Position Control Operation: Minus Direction

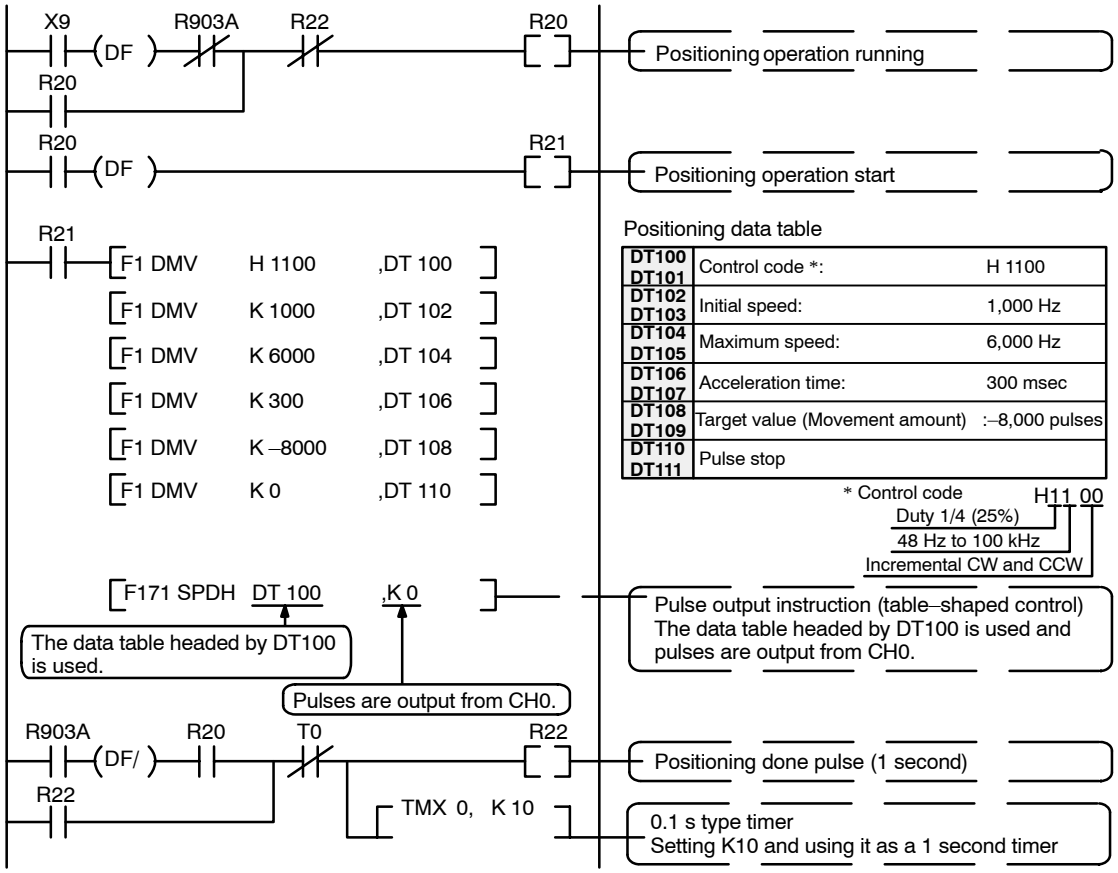
When X9 (PosStartMinus) turns on, the pulse is output from CCW output Y1 (PulseOutCCW) of the specified channel CH0. (Y1 is used implicitly by F171_SPDH.)



Pulse output diagram



FPWIN GR:


X9
DF
R903A
R22
R20
Positioning operation running
R20
R20
DF
R21
Positioning operation start
R21
F1 DMV H 1100 ,DT 100
F1 DMV K 1000 ,DT 102
F1 DMV K 6000 ,DT 104
F1 DMV K 300 ,DT 106
F1 DMV K –8000 ,DT 108
F1 DMV K 0 ,DT 110
Positioning data table
DT100 DT101 Control code *: H 1100
DT102 DT103 Initial speed: 1,000 Hz
DT104 DT105 Maximum speed: 6,000 Hz
DT106 DT107 Acceleration time: 300 msec
DT108 DT109 Target value (Movement amount) :–8,000 pulses
DT110 DT111 Pulse stop
* Control code H11 00
Duty 1/4 (25%)
48 Hz to 100 kHz
Incremental CW and CCW
F171 SPDH DT 100 ,K 0
The data table headed by DT100 is used.
Pulses are output from CH0.
Pulse output instruction (table–shaped control)
The data table headed by DT100 is used and pulses are output from CH0.
R903A
DF/
R20
T0
R22
R22
Positioning done pulse (1 second)
TMX 0, K 10
0.1 s type timer
Setting K10 and using it as a 1 second timer

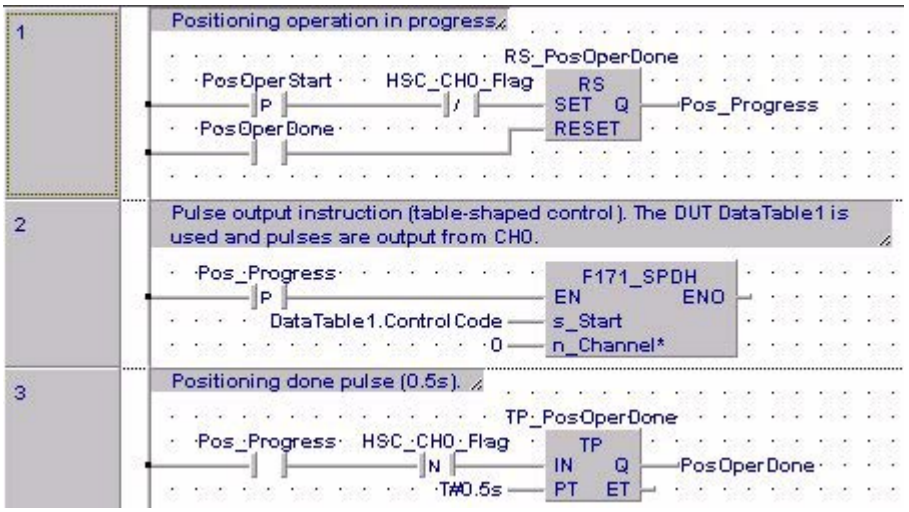
FPWIN Pro:

The GVL and DUT shown on page 7-62 apply to this program.

POU Header

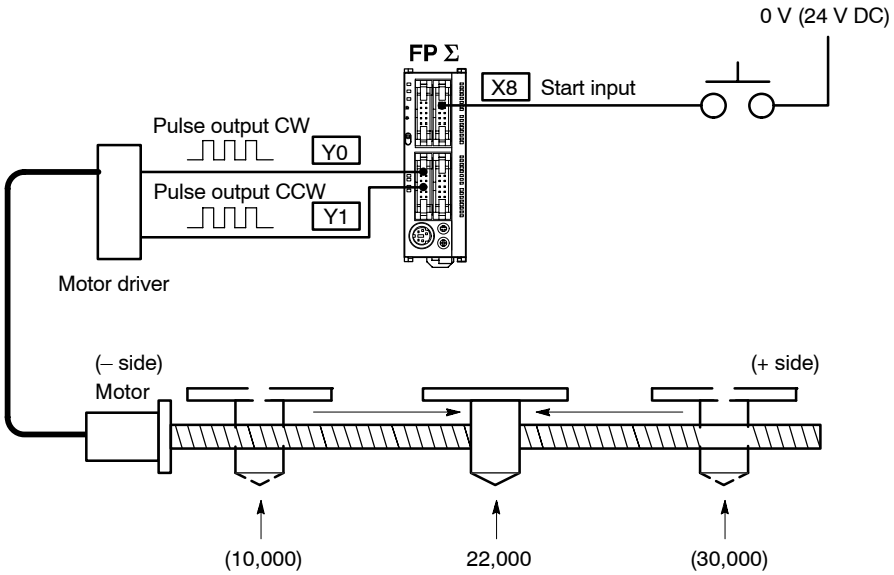
	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	PosStartMinus	BOOL	FALSE	Positioning start signal (-)
1	VAR_EXTERNAL	PulseOutCW	BOOL	FALSE	Pulse output CW
2	VAR_EXTERNAL	PulseOutCCW	BOOL	FALSE	Pulse output CCW
3	VAR_EXTERNAL	HSC_CH0_Flag	BOOL	FALSE	High-speed counter control flag for CH0
4	VAR	Pos_Progress	BOOL	FALSE	Positioning in progress
5	VAR	PosOperStart	BOOL	FALSE	Positioning operation start
6	VAR	PosOperDone	BOOL	FALSE	Positioning done pulse
7	VAR	DataTable1	F171_DUT	ControlCode := 16#1100, InitialSpeed := 1000, MaximumSpeed := 6000, AccelTime := 300, TargetVal := -8000, PulseStop := 0	Control code 16#1100= 1 = 25% duty 1 = 48 Hz to 100 kHz 00 = Incremental CW/CCW
8	VAR	RS_PosOperDone	RS		
9	VAR	TP_PosOperDone	TP		

LD Body



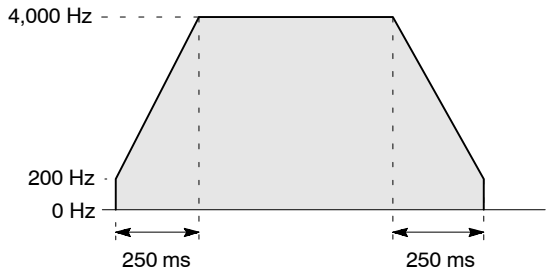
7.4.5.3 Absolute Position Control Operation

When X8 (PosStartPlus) is turned on, pulses are output from CW output Y0 (PulseOutCW) or CCW output Y1 (PulseOutCCW) of the specified channel CH0. If the current value at that point is larger than 22,000, the pulses are output from Y1, and if the value is smaller than 22,000, the pulses are output from Y0. (Y0 and Y1 are used implicitly by F171_SPDH.)

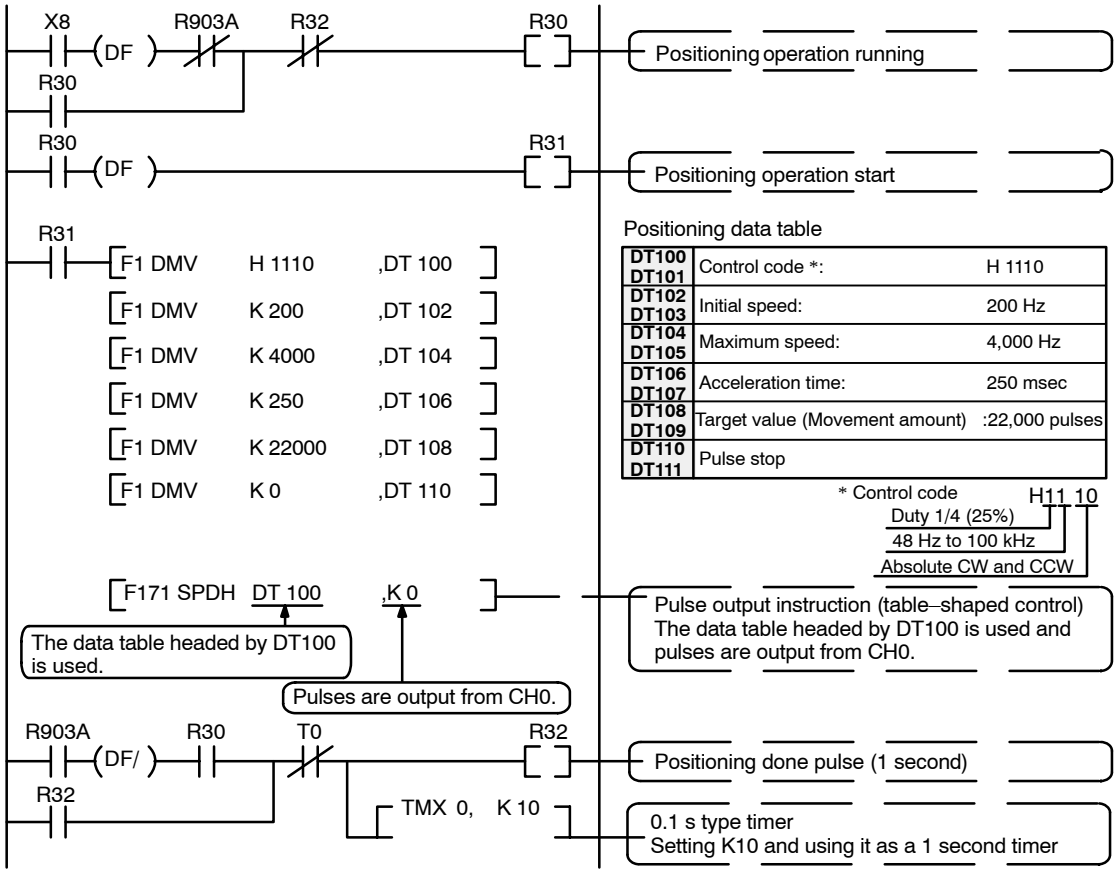


Regardless of the current value, its movement is towards position 22,000.

Pulse output diagram



FPWIN GR:


X8
DF
R903A
R32
R30
R30
R30
DF
R31
Positioning operation running
Positioning operation start
R31
F1 DMV H 1110 ,DT 100
F1 DMV K 200 ,DT 102
F1 DMV K 4000 ,DT 104
F1 DMV K 250 ,DT 106
F1 DMV K 22000 ,DT 108
F1 DMV K 0 ,DT 110
Positioning data table
DT100 DT101 Control code *: H 1110
DT102 DT103 Initial speed: 200 Hz
DT104 DT105 Maximum speed: 4,000 Hz
DT106 DT107 Acceleration time: 250 msec
DT108 DT109 Target value (Movement amount) :22,000 pulses
DT110 DT111 Pulse stop
* Control code H11 10
Duty 1/4 (25%)
48 Hz to 100 kHz
Absolute CW and CCW
F171 SPDH DT 100 ,K 0
The data table headed by DT100 is used.
Pulses are output from CH0.
Pulse output instruction (table–shaped control)
The data table headed by DT100 is used and pulses are output from CH0.
R903A
DF/
R30
T0
R32
R32
TMX 0, K 10
Positioning done pulse (1 second)
0.1 s type timer
Setting K10 and using it as a 1 second timer

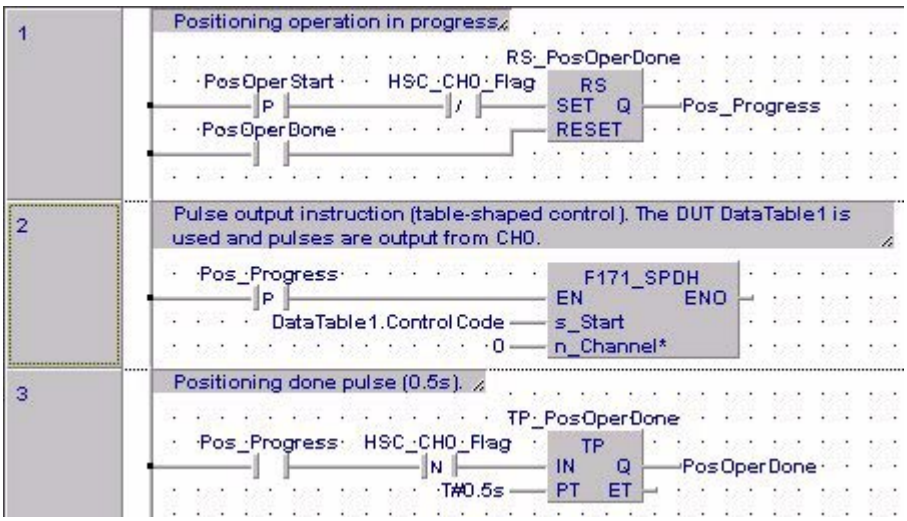
FPWIN Pro:

The GVL and DUT shown on page 7-62 apply to this program.

POU Header

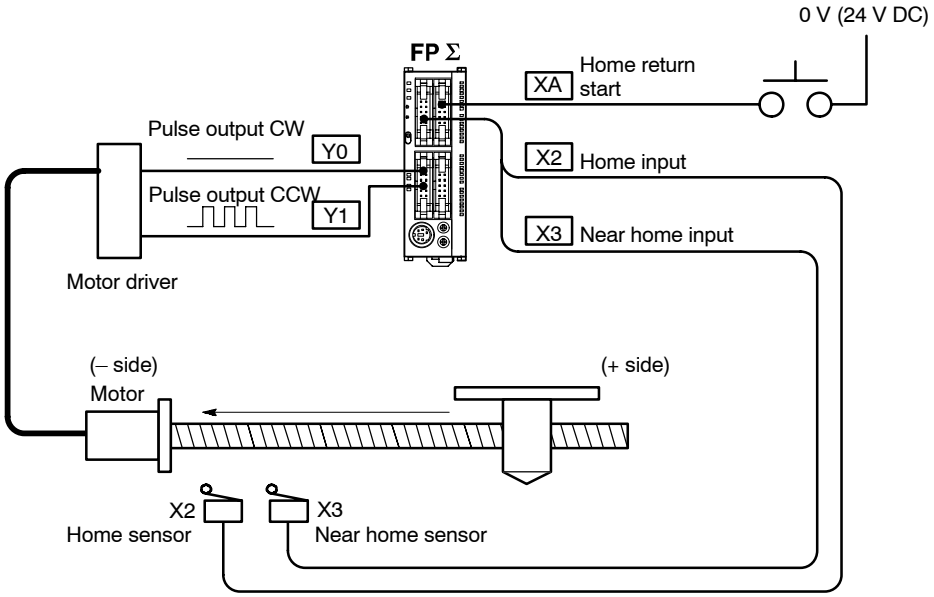
	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	PosStartPlus	BOOL	FALSE	Positioning start signal (+)
1	VAR_EXTERNAL	PulseOutCW	BOOL	FALSE	Pulse output CW
2	VAR_EXTERNAL	PulseOutCCW	BOOL	FALSE	Pulse output CCW
3	VAR_EXTERNAL	HSC_CH0_Flag	BOOL	FALSE	High-speed counter control flag for CH0
4	VAR	Pos_Progress	BOOL	FALSE	Positioning in progress
5	VAR	PosOperStart	BOOL	FALSE	Positioning operation start
6	VAR	PosOperDone	BOOL	FALSE	Positioning done pulse
7	VAR	DataTable1	F171_DUT	ControlCode := 16#1110, InitialSpeed := 200, MaximumSpeed := 4000, AccelTime := 250, TargetVal := 22000, PulseStop := 0	Control code 16#1110= 1 = 25% duty 1 = 48 Hz to 100 kHz 10 = Absolute CW and CCW
8	VAR	RS_PosOperDone	RS		
9	VAR	TP_PosOperDone	TP		

LD Body

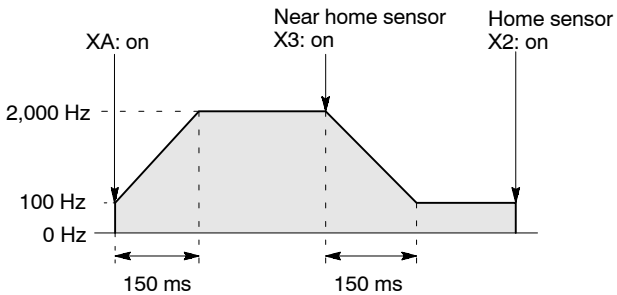


7.4.5.4 Home Return Operation: Minus Direction

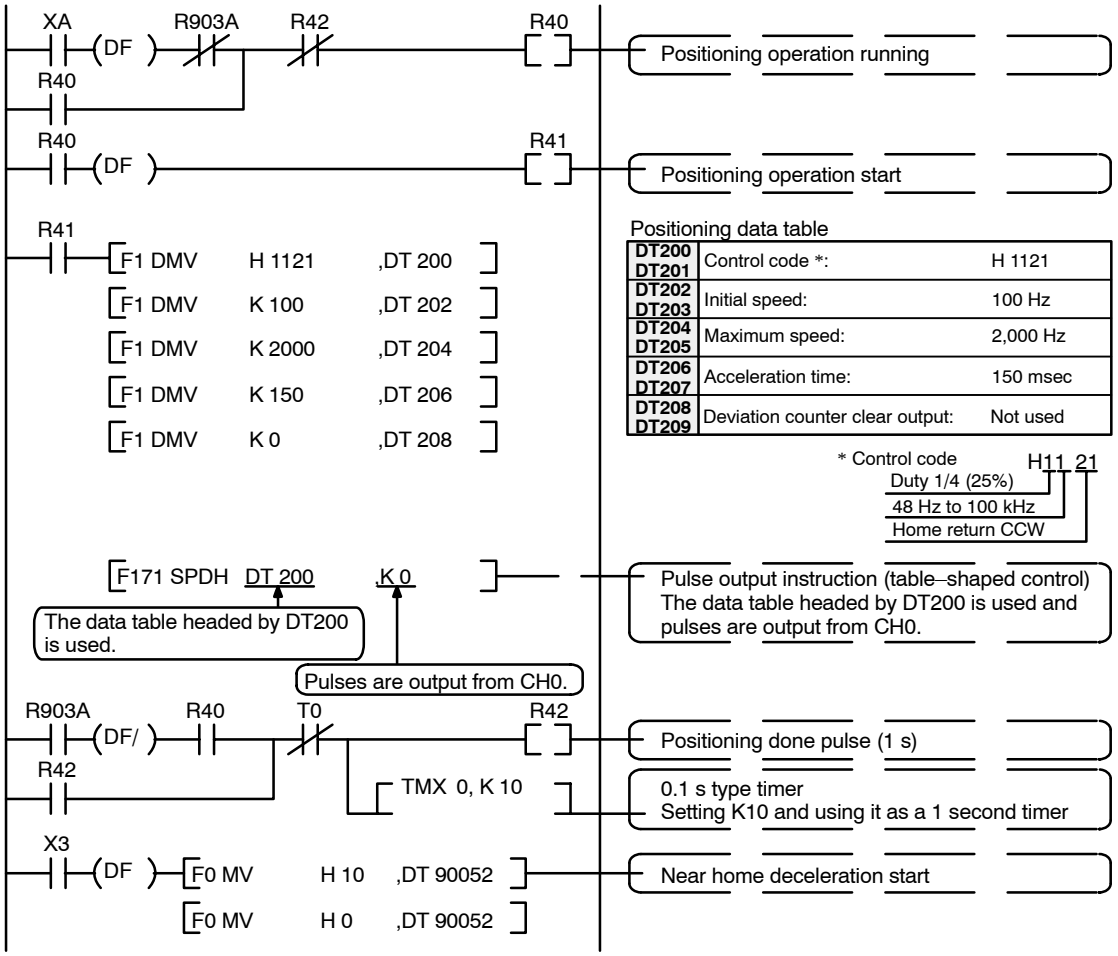
When XA (HomeReturnStart) turns on, the pulse is output from CCW output Y1 (PulseOutCCW) of the specified channel CH0 and the return to home begins. When X3 (NearHomeSensorIn) turns on, deceleration begins, and when X2 (HomeSensorInput) turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90044 and DT90045 are cleared to 0. (Y1 is used implicitly by F171_SPDH.)



Pulse output diagram



FPWIN GR:


XA
R903A
R42
R40
DF
Positioning operation running
R40
R40
R41
DF
Positioning operation start
R41
F1 DMV H 1121 ,DT 200
F1 DMV K 100 ,DT 202
F1 DMV K 2000 ,DT 204
F1 DMV K 150 ,DT 206
F1 DMV K 0 ,DT 208
Positioning data table
DT200 DT201 Control code *: H 1121
DT202 DT203 Initial speed: 100 Hz
DT204 DT205 Maximum speed: 2,000 Hz
DT206 DT207 Acceleration time: 150 msec
DT208 DT209 Deviation counter clear output: Not used
* Control code H11 21
Duty 1/4 (25%)
48 Hz to 100 kHz
Home return CCW
F171 SPDH DT 200 ,K 0
The data table headed by DT200 is used.
Pulses are output from CH0.
Pulse output instruction (table–shaped control)
The data table headed by DT200 is used and pulses are output from CH0.
R903A
R40
T0
R42
DF/
Positioning done pulse (1 s)
R42
TMX 0, K 10
0.1 s type timer
Setting K10 and using it as a 1 second timer
X3
DF
F0 MV H 10 ,DT 90052
F0 MV H 0 ,DT 90052
Near home deceleration start

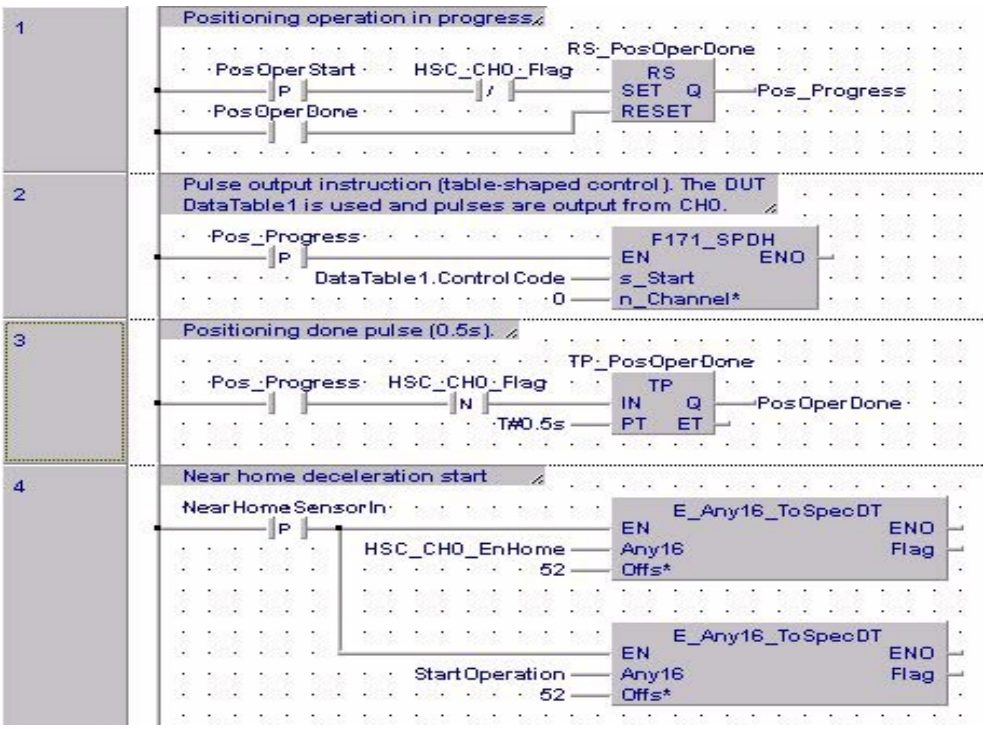
FPWIN Pro:

The GVL and DUT shown on page 7-62 apply to this program.

POU Header

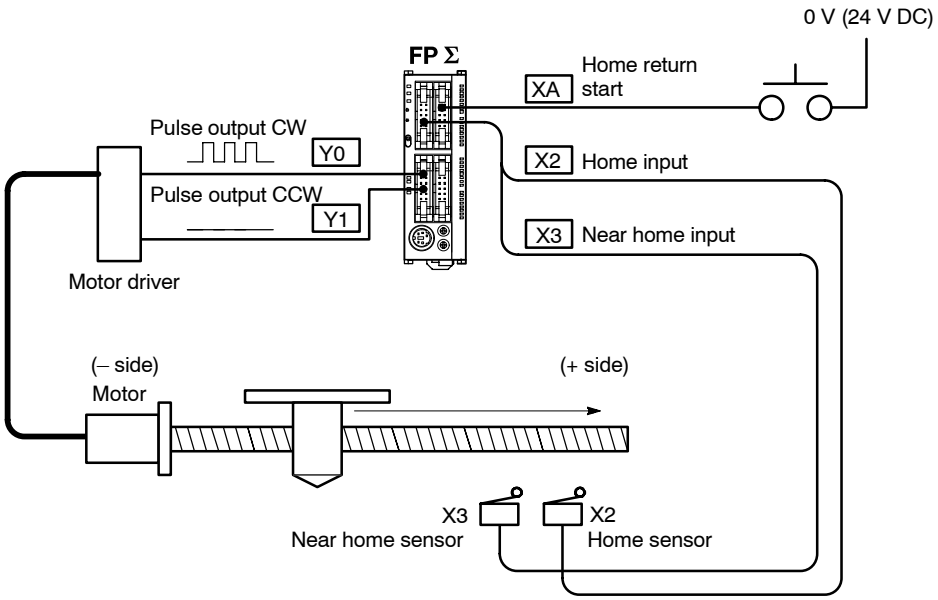
	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	HomeSensorInput	BOOL	FALSE	Home sensor input
1	VAR_EXTERNAL	NearHomeSensorIn	BOOL	FALSE	Near home sensor input
2	VAR_EXTERNAL	HomeReturnStart	BOOL	FALSE	Home return start signal
3	VAR_EXTERNAL	PulseOutCW	BOOL	FALSE	Pulse output CW
4	VAR_EXTERNAL	PulseOutCCW	BOOL	FALSE	Pulse output CCW
5	VAR_EXTERNAL	HSC_CH0_Flag	BOOL	FALSE	High-speed counter control flag for CH0
6	VAR	Pos_Progress	BOOL	FALSE	Positioning in progress
7	VAR	PosOperStart	BOOL	FALSE	Positioning operation start
8	VAR	PosOperDone	BOOL	FALSE	Positioning done pulse
9	VAR	DataTable1	F171_DUT	ControlCode := 16#1121, InitialSpeed := 100, MaximumSpeed := 2000, AccelTime := 150, TargetVal := 0, PulseStop := 0	Control code 16#1121= 1 = 25% duty 1 = 48 Hz to 100 kHz 21 = Home return CCW
10	VAR	HSC_CH0_EnHome	WORD	16#10	Enables near home input
11	VAR	StartOperation	WORD	0	Starts preset operation
12	VAR	RS_PosOperDone	RS		
13	VAR	TP_PosOperDone	TP		

LD Body

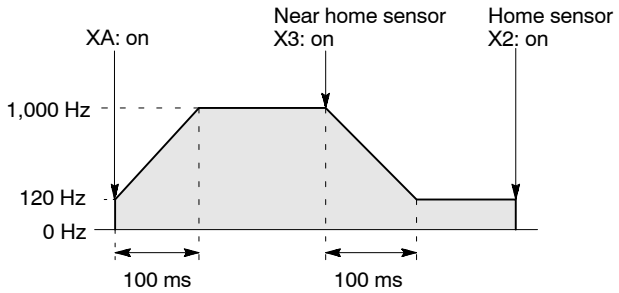


7.4.5.5 Home Return Operation: Plus Direction

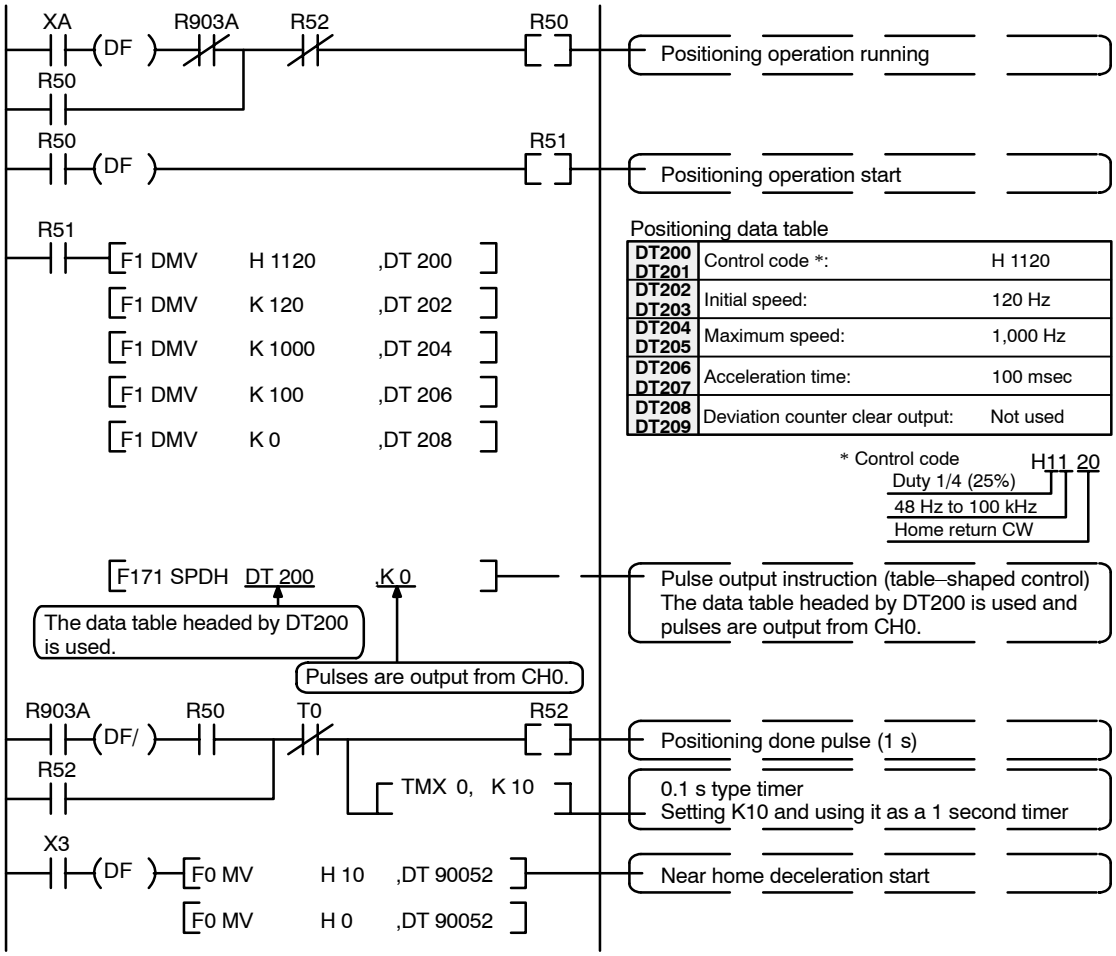
When XA (HomeReturnStart) turns on, a pulse is output from CW output Y0 (PulseOutCW) of the specified channel CH0 and the return to home begins. When X3 (NearHomeSensorIn) turns on, deceleration begins, and when X2 (HomeSensorInput) turns on, home return is completed. After the return to home is completed, the elapsed value areas DT90044 and DT90045 are cleared to 0. (Y0 is used implicitly by F171_SPDH.)



Pulse output diagram



FPWIN GR:


XA
DF
R903A
R52
R50
R50
R50
DF
R51
Positioning operation running
Positioning operation start
R51
F1 DMV H 1120 ,DT 200
F1 DMV K 120 ,DT 202
F1 DMV K 1000 ,DT 204
F1 DMV K 100 ,DT 206
F1 DMV K 0 ,DT 208
Positioning data table
DT200 DT201 Control code *: H 1120
DT202 DT203 Initial speed: 120 Hz
DT204 DT205 Maximum speed: 1,000 Hz
DT206 DT207 Acceleration time: 100 msec
DT208 DT209 Deviation counter clear output: Not used
* Control code H11 20
Duty 1/4 (25%)
48 Hz to 100 kHz
Home return CW
F171 SPDH DT 200 ,K 0
The data table headed by DT200 is used.
Pulses are output from CH0.
Pulse output instruction (table–shaped control)
The data table headed by DT200 is used and pulses are output from CH0.
R903A
DF/
R50
T0
R52
R52
TMX 0, K 10
Positioning done pulse (1 s)
0.1 s type timer
Setting K10 and using it as a 1 second timer
X3
DF
F0 MV H 10 ,DT 90052
F0 MV H 0 ,DT 90052
Near home deceleration start

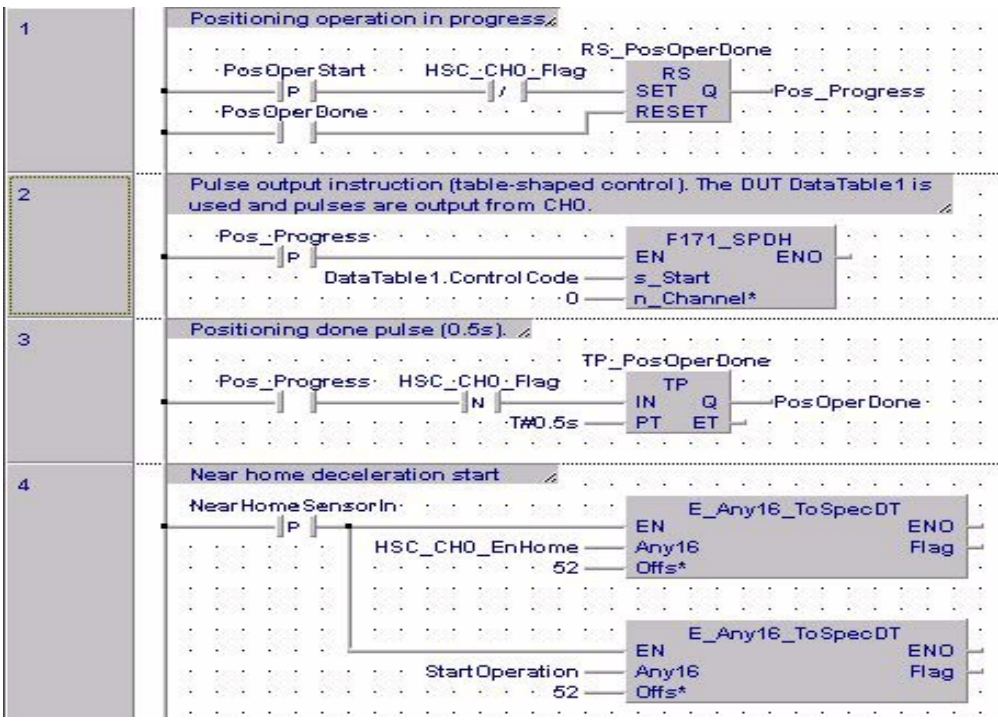
FPWIN Pro:

The GVL and DUT shown on page 7-62 apply to this program.

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	HomeSensorInput	BOOL	FALSE	Home sensor input
1	VAR_EXTERNAL	NearHomeSensorIn	BOOL	FALSE	Near home sensor input
2	VAR_EXTERNAL	HomeReturnStart	BOOL	FALSE	Home return start signal
3	VAR_EXTERNAL	PulseOutCW	BOOL	FALSE	Pulse output CW
4	VAR_EXTERNAL	PulseOutCCW	BOOL	FALSE	Pulse output CCW
5	VAR_EXTERNAL	HSC_CH0_Flag	BOOL	FALSE	High-speed counter control flag for CH0
6	VAR	Pos_Progress	BOOL	FALSE	Positioning in progress
7	VAR	PosOperStart	BOOL	FALSE	Positioning operation start
8	VAR	PosOperDone	BOOL	FALSE	Positioning done pulse
9	VAR	DataTable1	F171_DUT	ControlCode := 16#1120, InitialSpeed := 120, MaximumSpeed := 1000, AccelTime := 100, TargetVal := 0, PulseStop := 0	Control code 16#1120= 1 = 25% duty 1 = 48 Hz to 100 kHz 20 = Home return CW
10	VAR	HSC_CH0_EnHome	WORD	16#10	Enables near home input
11	VAR	StartOperation	WORD	0	Starts preset operation
12	VAR	RS_PosOperDone	RS		
13	VAR	TP_PosOperDone	TP		

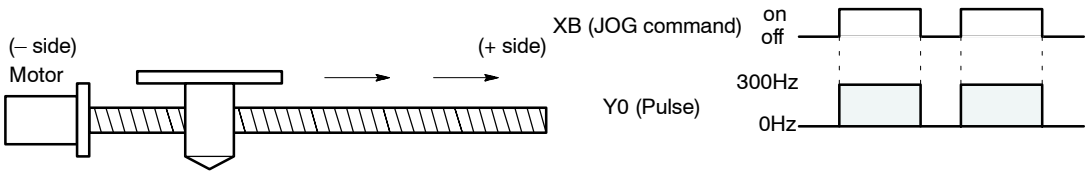
LD Body



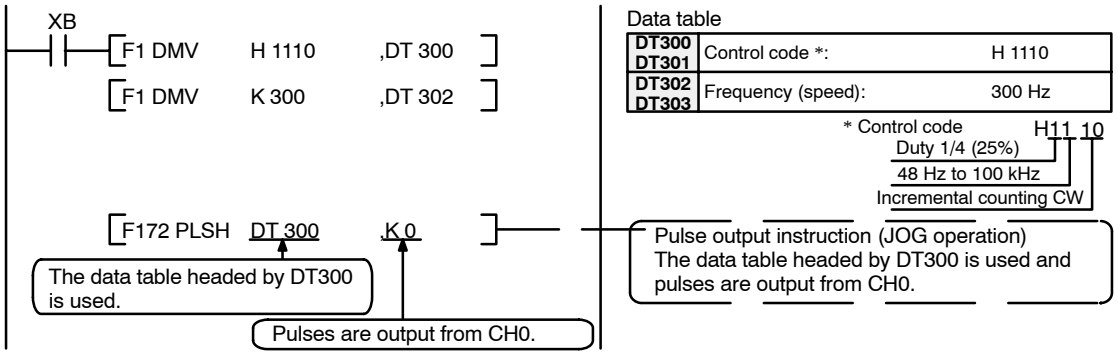
7.4.5.6 JOG Operation: Plus Direction

While XB (JOGStartPlus) is in the ON state, a pulse is output from the CW output Y0 (PulseOutCW) of the specified channel CH0. (Y0 is used implicitly by F172_SPDH.)

Pulse output diagram



FPWIN GR:


XB
F1 DMV H 1110 ,DT 300
F1 DMV K 300 ,DT 302
F172 PLSH DT 300 ,K 0
The data table headed by DT300 is used.
Pulses are output from CH0.
Data table
DT300 DT301 Control code *: H 1110
DT302 DT303 Frequency (speed): 300 Hz
* Control code H11 10
Duty 1/4 (25%)
48 Hz to 100 kHz
Incremental counting CW
Pulse output instruction (JOG operation)
The data table headed by DT300 is used and pulses are output from CH0.

FPWIN Pro:

The GVL shown on page 7-62 applies to this program.

DUT

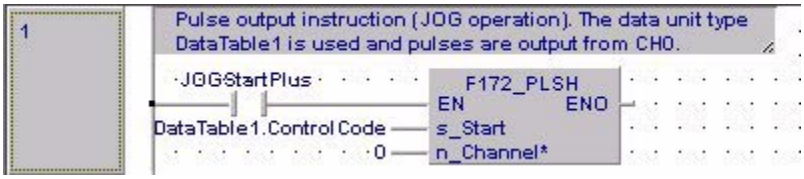
JOG [DUT]

	Identifier	Type	Initial	Comment
0	Control Code	DWORD	0	Highest WORD fixed to 0000 Lowest WORD = Control code
1	Frequency	DINT	0	Speed (Hz)

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	JOGStartPlus	BOOL	FALSE	JOG start signal (+)
1	VAR_EXTERNAL	PulseOutCW	BOOL	FALSE	Pulse output CW
2	VAR	DataTable1	JOG	Control Code := 1110, Frequency := 300	Control code 16#1110= 1 = 25% duty 1 = 48 Hz to 100 kHz 10 = Incremental CW

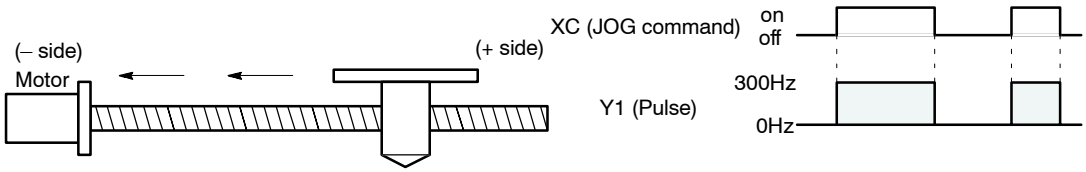
LD Body



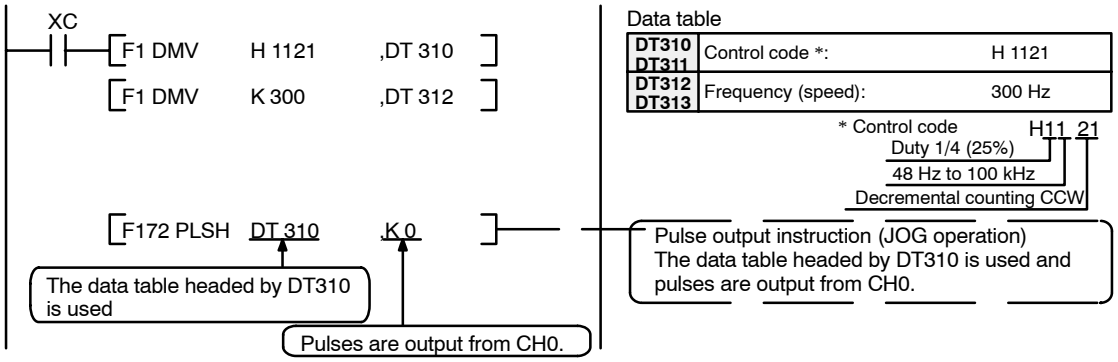
7.4.5.7 JOG Operation: Minus Direction

While XC (JOGStartMinus) is in the ON state, a pulse is output from the CCW output Y1 (PulseOutCCW) of the specified channel CH0. (Y1 is used implicitly by F172_SPDH.)

Pulse output diagram



FPWIN GR:


XC
F1 DMV H 1121 ,DT 310
F1 DMV K 300 ,DT 312
F172 PLSH DT 310 K 0
The data table headed by DT310 is used
Pulses are output from CH0.
Data table
DT310 DT311 Control code *: H 1121
DT312 DT313 Frequency (speed): 300 Hz
* Control code H11 21
Duty 1/4 (25%)
48 Hz to 100 kHz
Decremental counting CCW
Pulse output instruction (JOG operation)
The data table headed by DT310 is used and pulses are output from CH0.

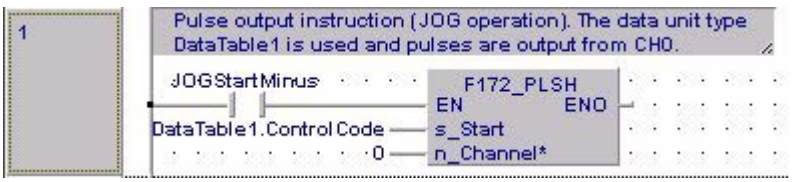
FPWIN Pro:

The GVL on page 7-62 and the DUT on page 7-79 shown above apply to this program.

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	JOGStartMinus	BOOL	FALSE	JOG start signal (-)
1	VAR_EXTERNAL	PulseOutCCW	BOOL	FALSE	Pulse output CCW
2	VAR	DataTable1	JOG	ControlCode := 1121, Frequency := 300	Control code 16#1121= 1 = 25% duty 1 = 48 Hz to 100 kHz 21 = Decremental CCW

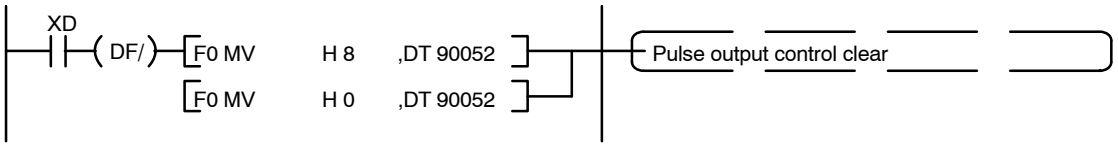
LD Body



7.4.5.8 Emergency Stop: Over Limit

If XD (OverrunSignal) turns off while a pulse is being output from Y0 (PulseOutCW), the output of the pulse is stopped. (Y0 is used implicitly by F172_SPDH.)

FPWIN GR:



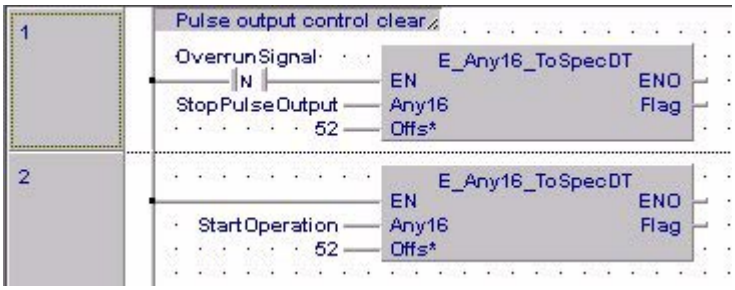
FPWIN Pro:

The GVL shown on page 7-62 above applies to this program.

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	OverrunSignal	BOOL	FALSE	Overrunning signal
1	VAR_EXTERNAL	PulseOutCW	BOOL	FALSE	Pulse output CW
2	VAR	StopPulseOutput	WORD	16#8	Performs a forced stop of the pulse output
3	VAR	StartOperation	WORD	0	Starts preset operation

LD Body

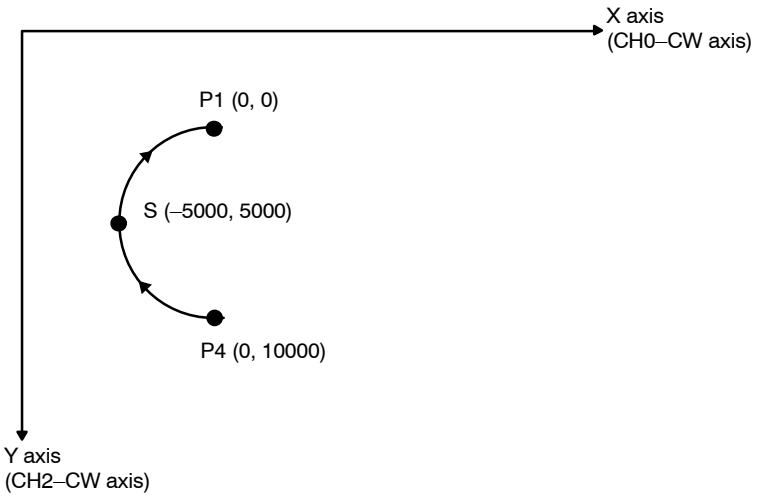


7.4.6 Sample Programs for Circular Interpolation

7.4.6.1 Pass Position Setting Method

–Using the current position P as a reference, designate the two points target position E and passing position S, and then perform positioning control using circular interpolation.

–In this program example, start from the current position P4 and then perform control until the target position P1 is reached via passing position S.



– I/O Allocation

I / Onumber	Description	I / O number	Description
XB	Positioning start	**R9010**	Always ON
XC	Emergency stop switch	**R903A**	Control flag (CH0)
R23	From P4 to P1 start	**R903C**	Control flag (CH2)
R2F	Positioning done	**R904E**	Circular interpolation control flag

– Allocation of data registers

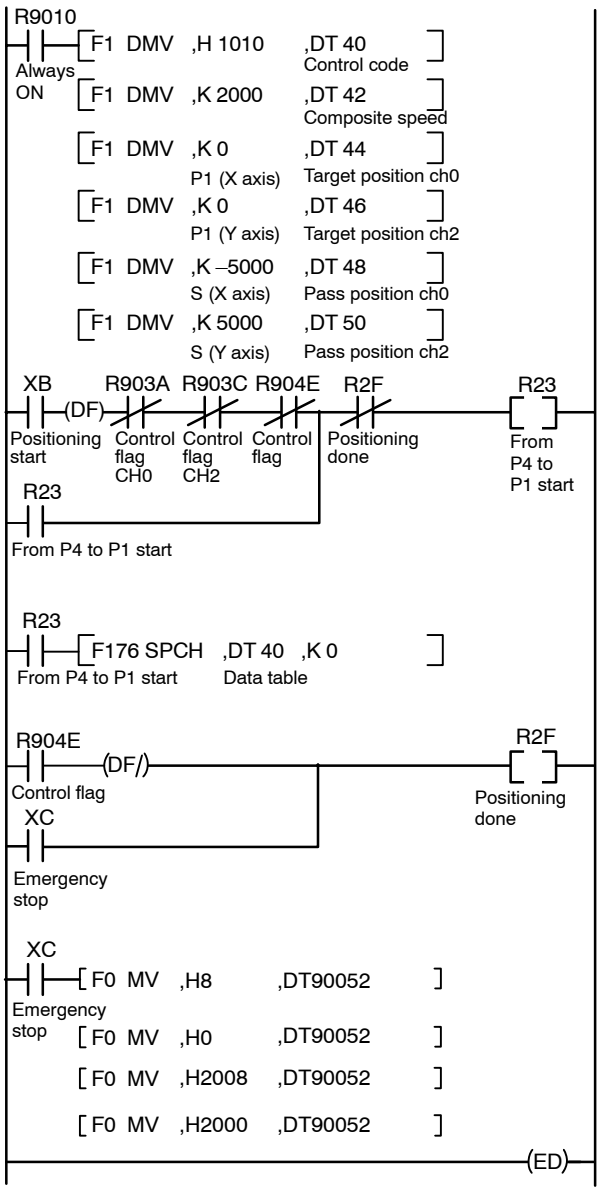
Item	Data number	Setting content	Set values in sample program
User setting area	DT40 to DT41	Control code	Stop mode, Absolute Pass position setting method From CH0–CW to CH2–CW direction
	DT42 to DT43	Composite speed	2000Hz
	DT44 to DT45	Target position (X–axis)	Target position P1 (X axis) : 0
	DT46 to DT47	Target position (Y–axis)	Target position P1 (Y axis) : 0
	DT48 to DT49	Pass position (X–axis)	Pass position S (X axis) : –5000
	DT50 to DT51	Pass position (Y–axis)	Pass position S (Y axis) : 5000
Work area	DT52 to DT57	Operation result storage area	Parameters calculated due to instruction execution are stored

– Sample program

Key Points:

–Designate the control code rotation direction with “from CH0–CW direction to CH2–CW direction”.
–Use the circular interpolation control flag R904E to verify completion of the circular interpolation action.

FPWIN GR:



Positioning data table

– Control code
Stop mode,
Pass position setting method
From CH0–CW to CH2–CW direction
Absolute (CW /CCW)
– Composite speed:2000Hz
– Target position :(0, 0)
– Pass position :(–5000, 5000)

Circular interpolation start

– In case of R903A, R903C, and R904E are OFF, If XB turns ON, circular interpolation start.

Positioning done

– R2F is controlled by R904E which we are able to confirm whether the positioning was done or not.

Emergency stop

– If XC turns ON, the output of the pulse is stopped.

FPWIN Pro:

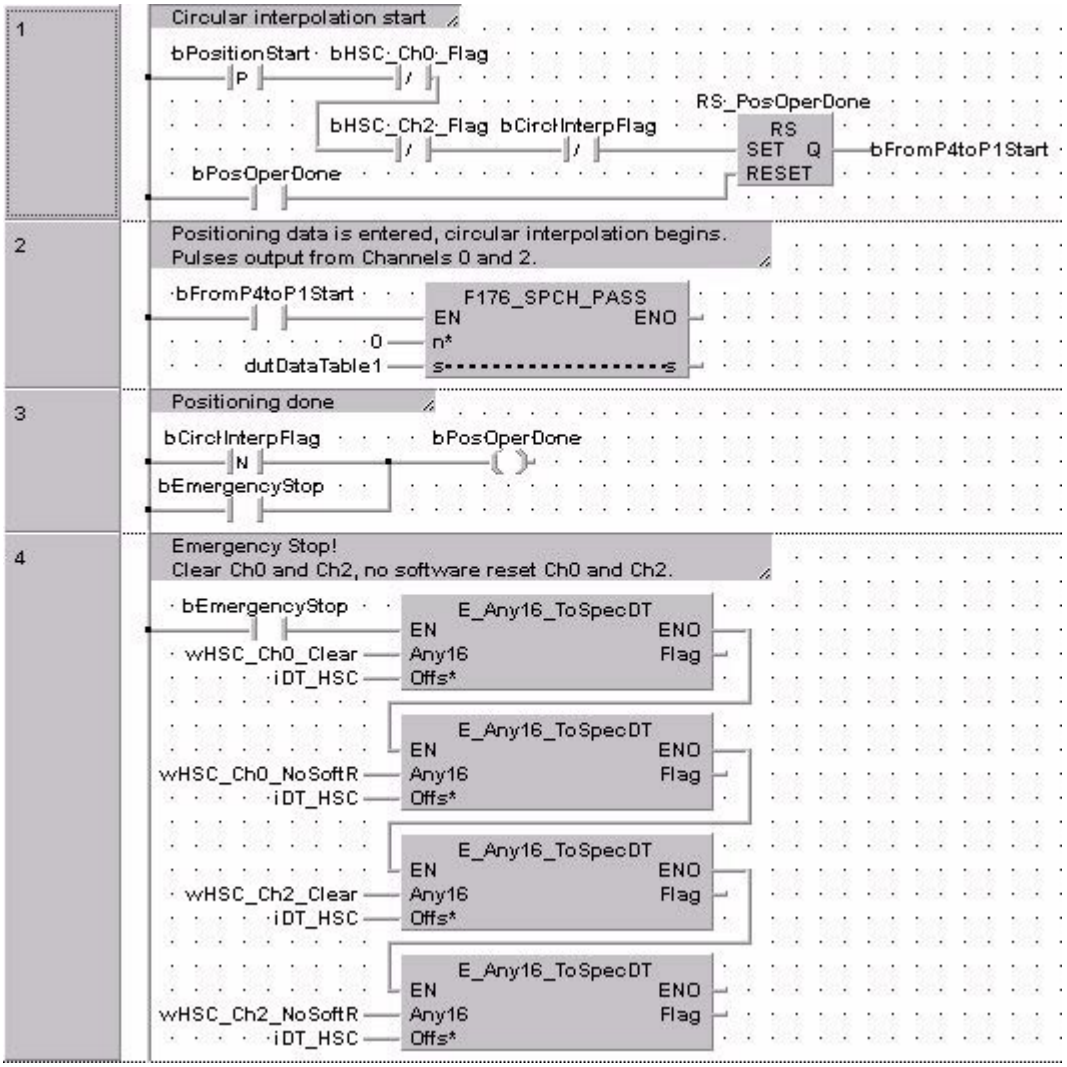
GVL

	Class	Identifier	Matsus	IEC_Address	Type	Initial
0	VAR_GLOBAL	bPositionStart	XB	%IX0.11	BOOL	FALSE
1	VAR_GLOBAL	bEmergencyStop	XC	%IX0.12	BOOL	FALSE
2	VAR_GLOBAL	bHSC_Ch0_Flag	R903A	%MX0.903.10	BOOL	FALSE
3	VAR_GLOBAL	bHSC_Ch2_Flag	R903C	%MX0.903.12	BOOL	FALSE
4	VAR_GLOBAL	bCirclInterpFlag	R904E	%MX0.904.14	BOOL	FALSE
5	VAR_GLOBAL	bCirclntOverwrit	R904F	%MX0.904.15	BOOL	FALSE
6	VAR_GLOBAL	iShiftRegister	WR1	%MW0.1	INT	0

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	bPositionStart	BOOL	FALSE	
1	VAR_EXTERNAL	bHSC_Ch0_Flag	BOOL	FALSE	
2	VAR_EXTERNAL	bHSC_Ch2_Flag	BOOL	FALSE	
3	VAR_EXTERNAL	bCirclInterpFlag	BOOL	FALSE	
4	VAR	RS_PosOperDone	RS		
5	VAR	bPosOperDone	BOOL	FALSE	
6	VAR	bFromP4toP1Start	BOOL	FALSE	
- 7	VAR	dutDataTable1	PULSE_ARC_PASS	ControlCode := 16#1010, Speed := 2000, TargetPos_X := 0, TargetPos_Y := 0, PassPos_X := -5000, PassPos_Y := 5000	16#1010 = Stop mode, Pass position setting method, From CH0 - CW to CH2 - CW dir., Absolute (CW/CCW)
8	VAR_EXTERNAL	bEmergencyStop	BOOL	FALSE	
9	VAR_CONSTANT	iDT_HSC	INT	52	
10	VAR	wHSC_Ch0_Clear	WORD	16#8	
11	VAR	wHSC_Ch0_NoSoftR	WORD	16#0	No software reset, Ch0
12	VAR	wHSC_Ch2_Clear	WORD	16#2008	
13	VAR	wHSC_Ch2_NoSoftR	WORD	16#2000	No software reset, Ch2

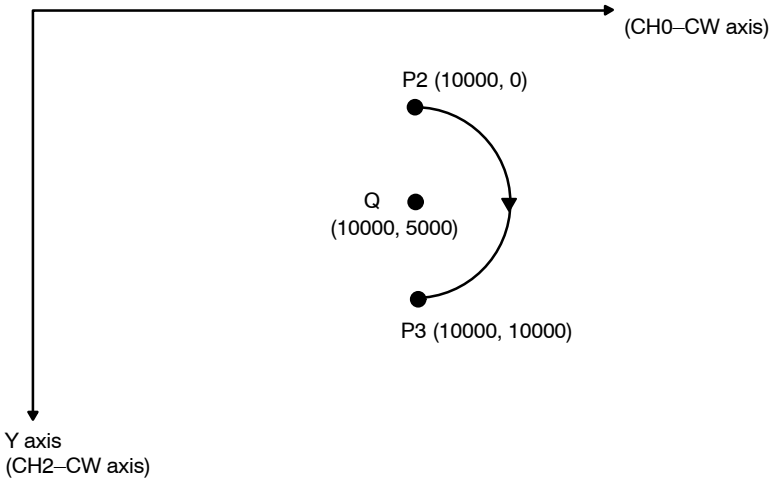
LD Body


1
Circular interpolation start
bPositionStart
P
bHSC_Ch0_Flag
/
RS_PosOperDone
bHSC_Ch2_Flag
/
bCircInterpFlag
/
RS
SET Q
RESET
bFromP4toP1Start
bPosOperDone
2
Positioning data is entered, circular interpolation begins.
Pulses output from Channels 0 and 2.
bFromP4toP1Start
F176_SPCH_PASS
EN
ENO
0
n*
dutDataTable1
s
s
3
Positioning done
bCircInterpFlag
N
bPosOperDone
bEmergencyStop
4
Emergency Stop!
Clear Ch0 and Ch2, no software reset Ch0 and Ch2.
bEmergencyStop
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch0_Clear
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch0_NoSoftR
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch2_Clear
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch2_NoSoftR
Any16
Flag
iDT_HSC
Offs*

7.4.6.2 Center Position Setting Method

–Using current position P as a reference, designate target position E and center position Q, which will be the reference point for drawing the circle, and perform positioning control using circular interpolation.

–In this program example, start from current position P2 and, using circle center position Q as a reference point, perform control until target position P3 is reached.



I/O Allocation

I / Onumber	Description	I / Onumber	Description
XB	Positioning start	**R9010**	Always ON
XC	Emergency stop switch	**R903A**	Control flag (CH0)
R21	From P2 to P3 start	**R903C**	Control flag (CH2)
R2F	Positioning done	**R904E**	Circular interpolation control flag

– Allocation of data registers

Item	Data number	Setting content	Set values in sample program
User setting area	DT60 to DT61	Control code	Stop mode, Absolute Center position setting method From CH0–CW to CH2–CW direction
	DT62 to DT63	Composite speed	2000Hz
	DT64 to DT65	Target position (X–axis)	Target position P3 (X axis) : 10000
	DT66 to DT67	Target position (Y–axis)	Target position P3 (Y axis) : 10000
	DT68 to DT69	Center position (X–axis)	Center Position Q (X axis) : 10000
	DT70 to DT71	Center position (Y–axis)	Center Position Q (Y axis) : 5000
Work area	DT72 to DT73	Operation result storage area	Parameters calculated due to instruction execution are stored

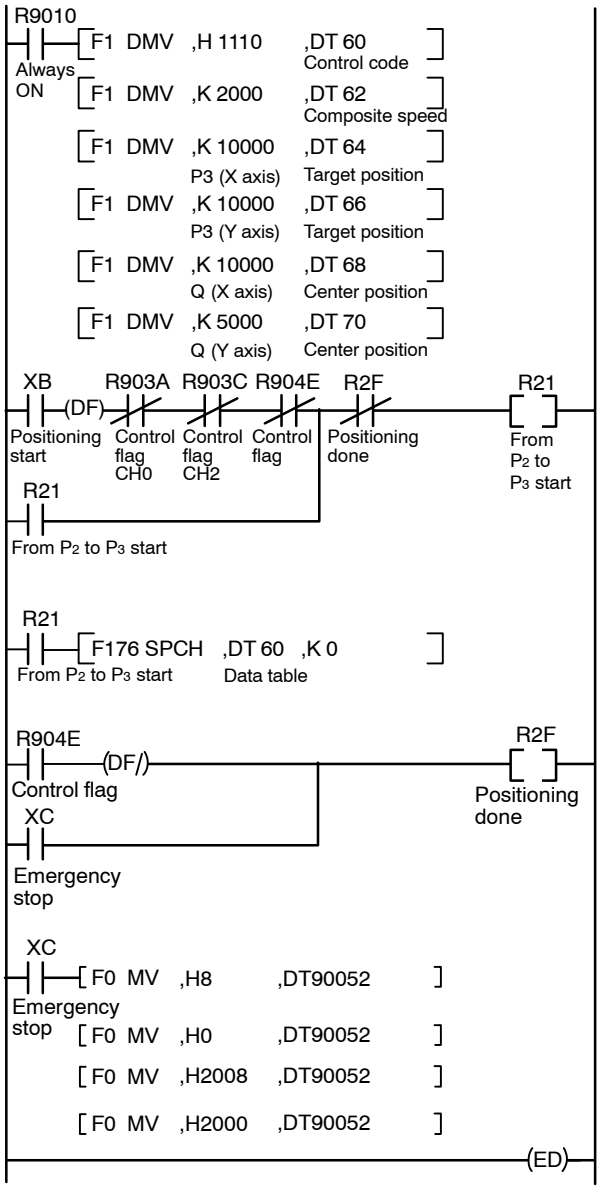
– Sample program

Key Points:

–Designate the control code rotation direction with “from CH0–CW direction to CH2–CW direction”.

–Use the circular interpolation control flag R904E to verify completion of the circular interpolation action.

FPWIN GR:



Positioning data table

– Control code
Stop mode,
Center position setting method
From CH0–CW to CH2–CW direction
Absolute (CW /CCW)
– Composite speed:2000Hz
– Target position :(10000, 10000)
– Center position :(10000, 5000)

Circular interpolation start

– In case of R903A, R903C and R904E are OFF. If XB turns ON, circular interpolation start.

Positioning done

– R2F is controlled by R904E which we are able to confirm whether the positioning was done or not.

Emergency stop

– If XC turns ON, the output of the pulse is stopped.

FPWIN Pro:

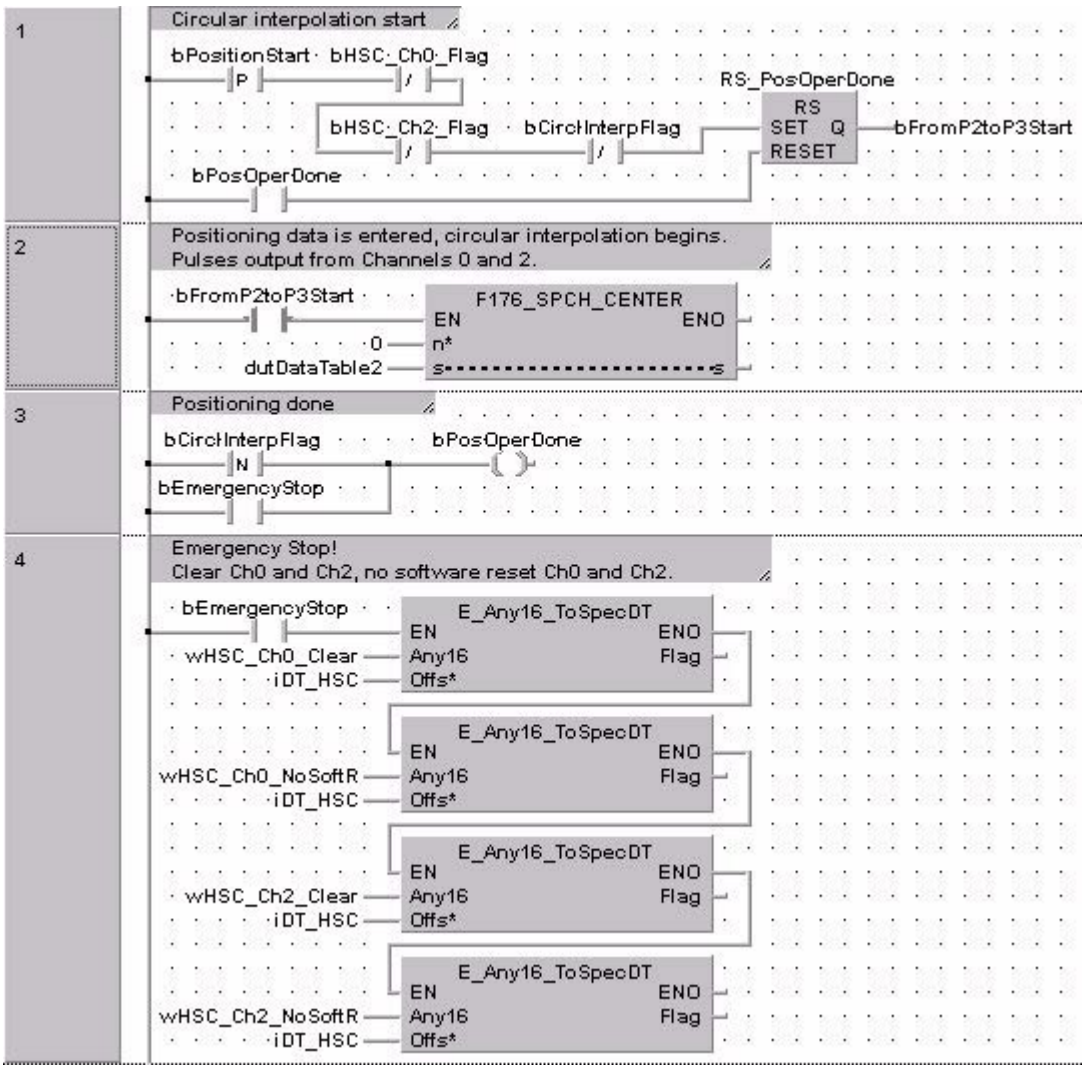
GVL

	Class	Identifier	Matsus	IEC_Address	Type	Initial
0	VAR_GLOBAL	bPositionStart	XB	%IX0.11	BOOL	FALSE
1	VAR_GLOBAL	bEmergencyStop	XC	%IX0.12	BOOL	FALSE
2	VAR_GLOBAL	bHSC_Ch0_Flag	R903A	%MX0.903.10	BOOL	FALSE
3	VAR_GLOBAL	bHSC_Ch2_Flag	R903C	%MX0.903.12	BOOL	FALSE
4	VAR_GLOBAL	bCirclInterpFlag	R904E	%MX0.904.14	BOOL	FALSE
5	VAR_GLOBAL	bCirclntOverwrit	R904F	%MX0.904.15	BOOL	FALSE
6	VAR_GLOBAL	iShiftRegister	WR1	%MW0.1	INT	0

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTER	bPositionStart	BOOL	FALSE	
1	VAR_EXTER	bHSC_Ch0_Flag	BOOL	FALSE	
2	VAR_EXTER	bHSC_Ch2_Flag	BOOL	FALSE	
3	VAR_EXTER	bCirclInterpFlag	BOOL	FALSE	
4	VAR	RS_PosOperDone	RS		
5	VAR	bPosOperDone	BOOL	FALSE	
6	VAR	bFromP2toP3Start	BOOL	FALSE	
7	VAR	dutDataTable2	PULSE_ARC_CENTER	ControlCode := 16#1110, Speed := 2000, TargetPos_X := 10000, TargetPos_Y := 10000, CenterPos_X := 10000, CenterPos_Y := 5000	16#1110 = Stop mode, Center position setting method, From CH0 - CW to CH2 - CW dir., Absolute (CW/CCW)
8	VAR_EXTER	bEmergencyStop	BOOL	FALSE	
9	VAR_CONST	iDT_HSC	INT	52	
10	VAR	wHSC_Ch0_Clear	WORD	16#8	
11	VAR	wHSC_Ch0_NoSoftR	WORD	16#0	No software reset, Ch0
12	VAR	wHSC_Ch2_Clear	WORD	16#2008	
13	VAR	wHSC_Ch2_NoSoftR	WORD	16#2000	No software reset, Ch2

LD Body


1
Circular interpolation start
bPositionStart
P
bHSC_Ch0_Flag
/
RS_PosOperDone
RS
SET Q
RESET
bHSC_Ch2_Flag
/
bCircInterpFlag
/
bFromP2toP3Start
bPosOperDone
2
Positioning data is entered, circular interpolation begins.
Pulses output from Channels 0 and 2.
bFromP2toP3Start
F176_SPCH_CENTER
EN
ENO
0
n*
dutDataTable2
s
s
3
Positioning done
bCircInterpFlag
N
bPosOperDone
bEmergencyStop
4
Emergency Stop!
Clear Ch0 and Ch2, no software reset Ch0 and Ch2.
bEmergencyStop
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch0_Clear
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch0_NoSoftR
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch2_Clear
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch2_NoSoftR
Any16
Flag
iDT_HSC
Offs*

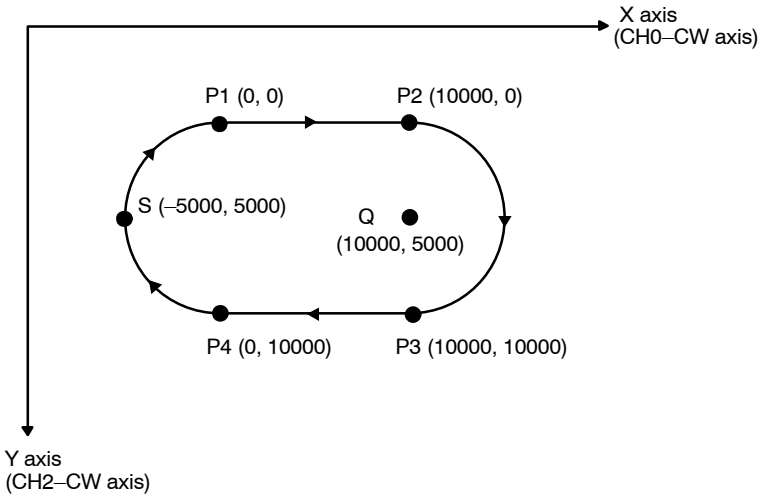
7.4.6.3 Interpolation Control (Linear and Circular)

–Using linear and circular interpolation functions, perform positioning control that draws a trajectory like the one shown below.

–The interval between the first position P1 and P2 and the interval between P3 and P4 perform control using linear interpolation.

–The interval between P2 and P3 performs circular interpolation control using center designation.

–The interval between P4 and P1 performs circular interpolation control using passing position designation.



– I/O Allocation

I / Onumber	Description	I / Onumber	Description
XB	Positioning start	**R9010**	Always ON
XC	Emergency stop switch	**R903A**	Control flag (CH0)
R20	From P1 to P2 start	**R903C**	Control flag (CH2)
R21	From P2 to P3 start	**R904E**	Circular interpolation control flag
R22	From P3 to P4 start		
R23	From P4 to P1 start		
R2F	Positioning done		

Key Points:

–With this program, because the next action that follows circular interpolation control is linear interpolation, the control code is designated with the stop mode.

–The rotation direction during circular interpolation is the same direction for both P2 to P3 and P4 to P1. Designate the control code rotation direction with ”from CH0–CW direction to CH2–CW direction.”

–Use the circular interpolation control flag R904E to verify completion of the circular interpolation action.

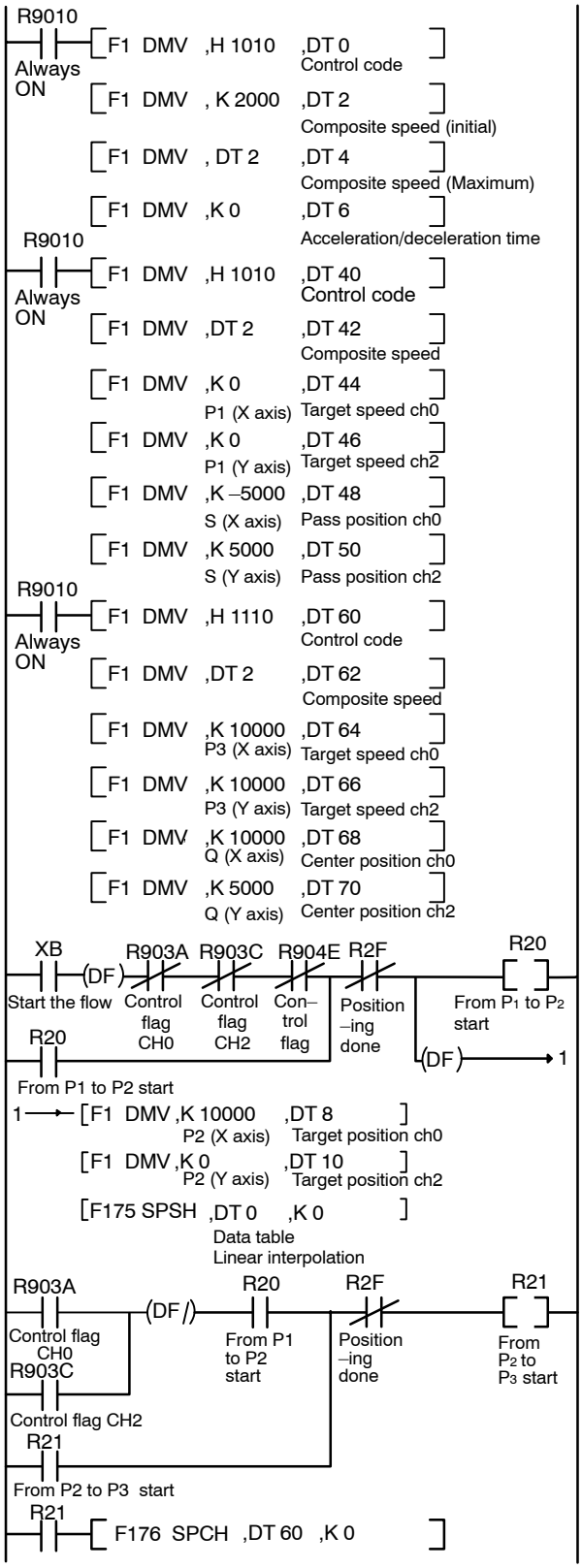
– Allocation of data registers

Item	Data register number	Description	Details
User setting area for linear interpolation	DT0 to DT1	Control code	Absolute
	DT2 to DT3	Startup speed	2000Hz
	DT4 to DT5	Target speed	2000Hz
	DT6	Acceleration / deceleration time	0ms
	DT8 to DT9	Target position (X–axis)	Target position P2 (X axis) : 10000 Target position P4 (X axis) : 0
	DT10 to DT11	Target position (Y–axis)	Target position P2 (Y axis) : 0 Target position P4 (Y axis) : 10000
Work area for linear interpolation	DT12 to DT23	Operation result storage area	Parameters calculated due to instruction execution are stored
User setting area for circular interpolation	DT40 to DT41	Control code	Stop mode, Absolute Pass position setting method From CH0–CW to CH2–CW direction
	DT42 to DT43	Composite speed	2000Hz
	DT44 to DT45	Target position (X–axis)	Target position P1 (X axis) : 0
	DT46 to DT47	Target position (Y–axis)	Target position P1 (Y axis) : 0
	DT48 to DT49	Pass position (X–axis)	Pass position S (X axis) : –5000
	DT50 to DT51	Pass position (Y–axis)	Pass position S (Y axis) : 5000
Work area	DT52 to DT57	Operation result storage area	Parameters calculated due to instruction execution are stored
User setting area for circular interpolation	DT60 to DT61	Control code	Stop mode, Absolute Center position setting method From CH0–CW to CH2–CW direction
	DT62 to DT63	Composite speed	2000Hz
	DT64 to DT65	Target position (X–axis)	Target position P3 (X axis) : 10000
	DT66 to DT67	Target position (Y–axis)	Target position P3 (Y axis) : 10000
	DT68 to DT69	Center position (X–axis)	Center Position Q (X axis) : 10000
	DT70 to DT71	Center position (Y–axis)	Center position Q (Y axis) : 5000
Work area	DT72 to DT73	Operation result storage area	Parameters calculated due to instruction execution are stored

– Sample program

FPWIN GR:

See following pages.



Positioning data table
(From P_1 to P_2 and from P_3 to P_4.)

– Control code : Absolute
– Composite speed : 2000Hz
– Acceleration/deceleration time : 0

Positioning data table
(From P_4 to P_1)

– Control code:
Stop mode, Pass position setting method
From CH0–CW to CH2–CW dierction
Absolute
– Composite speed: 2000Hz
– Target position : (0, 0)
– Pass position : (–5000, 5000)

Positioning data table
(From P_2 to P_3)

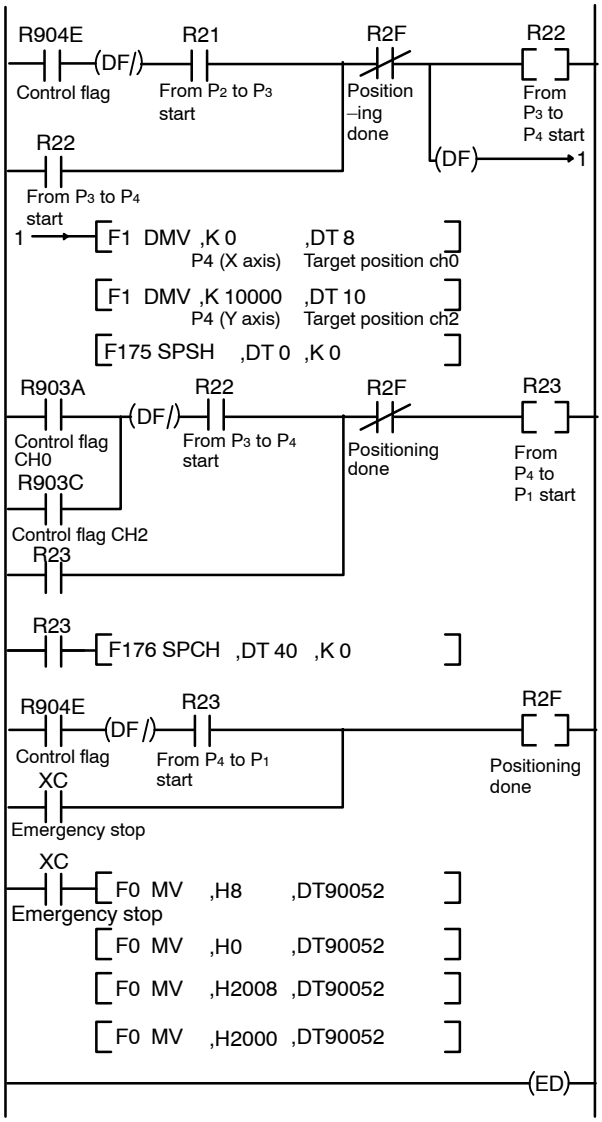
– Control code:
Stop mode, Center position setting method
From CH0–CW to CH2–CW dierction
Absolute
– Composite speed: 2000Hz
– Target position : (10000, 10000)
– Center postion : (10000, 5000)

Positioning (from P_1 to P_2)

– In case of R903A, R903C, and R904E are OFF, if XB turns ON, positioning is started.

Positioning (from P_2 to P_3)

– When R903A and R903C turns OFF, circular interpolation positioning is stared.



Positioning (from P3 to P4)

– When R904E turns OFF, positioning from P3 to P4 is started.

Positioning (from P4 to P1)

– When R903A and R903C turns OFF, the data for circular interpolation positioning is started.

Positioning done

– R2F is controlled by R904E witch are able to confirm whether the positioning was done or not.

Emergency stop

– If XC turns ON, the output of the pulse is stopped.

FPWIN Pro:

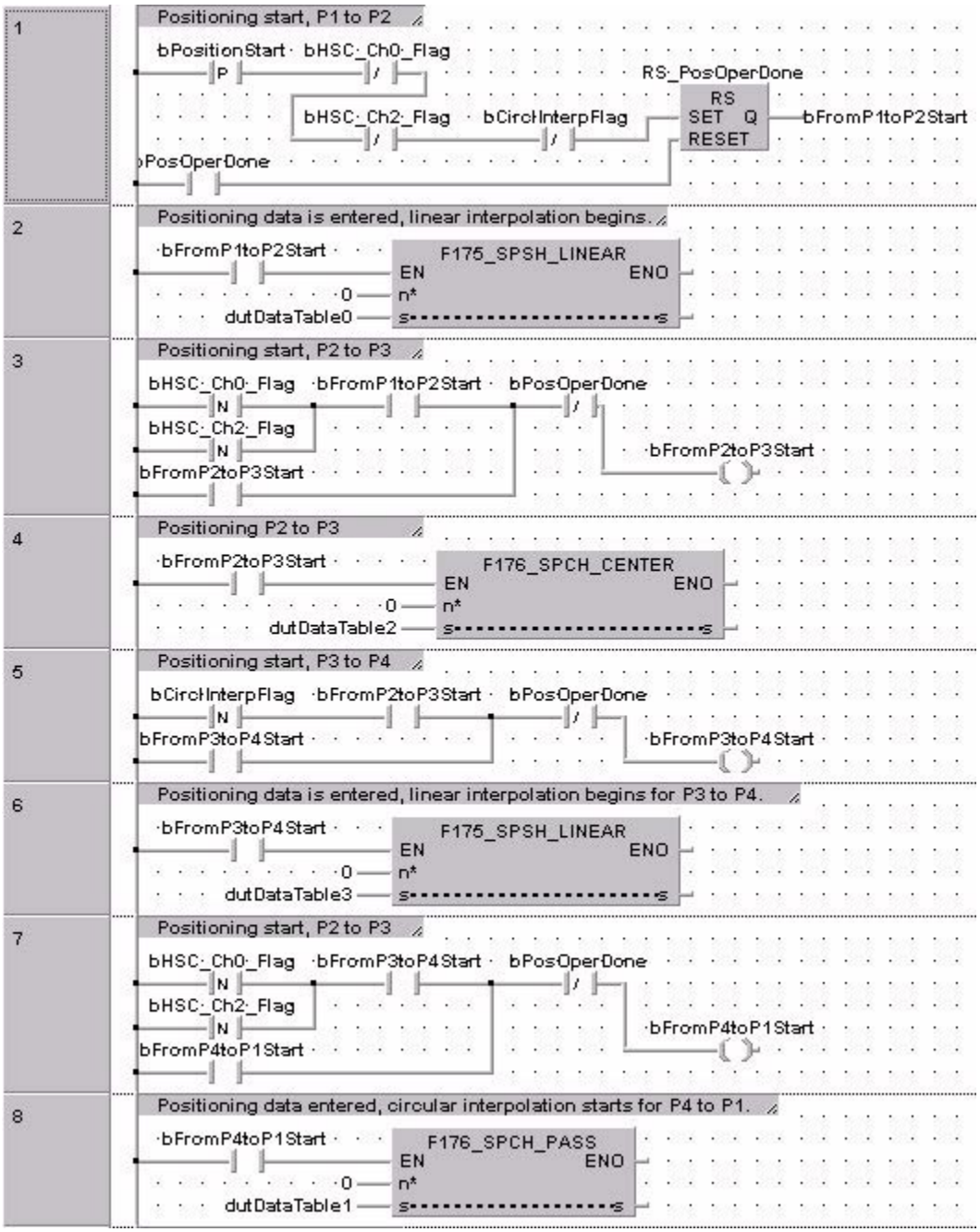
GVL

	Class	Identifier	Matsus	IEC_Address	Type	Initial
0	VAR_GLOBAL	bPositionStart	XB	%IX0.11	BOOL	FALSE
1	VAR_GLOBAL	bEmergencyStop	XC	%IX0.12	BOOL	FALSE
2	VAR_GLOBAL	bHSC_Ch0_Flag	R903A	%MX0.903.10	BOOL	FALSE
3	VAR_GLOBAL	bHSC_Ch2_Flag	R903C	%MX0.903.12	BOOL	FALSE
4	VAR_GLOBAL	bCirclInterpFlag	R904E	%MX0.904.14	BOOL	FALSE
5	VAR_GLOBAL	bCirclntOverwrit	R904F	%MX0.904.15	BOOL	FALSE
6	VAR_GLOBAL	iShiftRegister	WR1	%MW0.1	INT	0

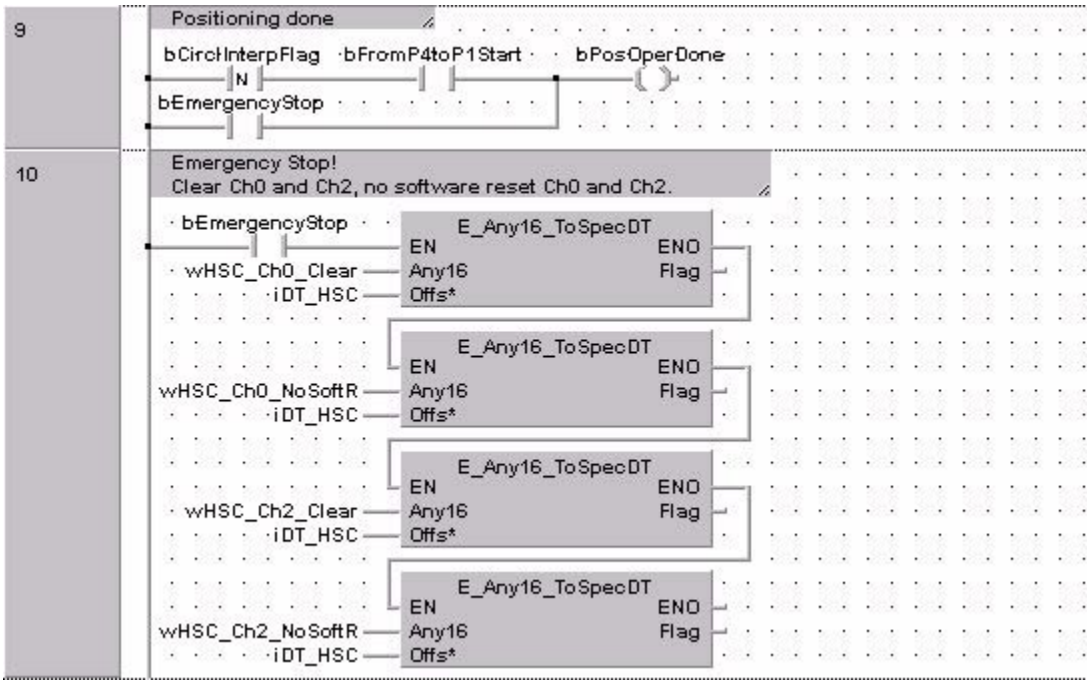
POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTER	bPositionStart	BOOL	FALSE	
1	VAR_EXTER	bHSC_Ch0_Flag	BOOL	FALSE	
2	VAR_EXTER	bHSC_Ch2_Flag	BOOL	FALSE	
3	VAR_EXTER	bCirclInterpFlag	BOOL	FALSE	
4	VAR	RS_PosOperDone	RS		
5	VAR	bPosOperDone	BOOL	FALSE	
6	VAR	bFromP1toP2Start	BOOL	FALSE	
7	VAR	bFromP2toP3Start	BOOL	FALSE	
8	VAR	bFromP3toP4Start	BOOL	FALSE	
9	VAR	bFromP4toP1Start	BOOL	FALSE	
- 10	VAR	dutDataTable0	PULSE_LINEAR	Control Code := 0, Initial Speed := 2000, Maximum Speed := 2000, Target Value_X := 10000, Target Value_Y := 0	16#0 = Absolute mode P1 -> P2
- 11	VAR	dutDataTable1	PULSE_ARC_PASS	Control Code := 16#1010, Speed := 2000, Target Pos_X := 0, Target Pos_Y := 0, Pass Pos_X := -5000, Pass Pos_Y := 5000	16#1010 = Stop mode, Pass position setting method, From CH0 - CW to CH2 - CW dir., Absolute (CW/CCW)
- 12	VAR	dutDataTable2	PULSE_ARC_CENTE	Control Code := 16#1110, Speed := 2000, Target Pos_X := 10000, Target Pos_Y := 10000, Center Pos_X := 10000, Center Pos_Y := 5000	16#1110 = Stop mode, Center position setting method, From CH0 - CW to CH2 - CW dir., Absolute (CW/CCW)
- 13	VAR	dutDataTable3	PULSE_LINEAR	Control Code := 0, Initial Speed := 2000, Maximum Speed := 2000, Target Value_X := 0, Target Value_Y := 10000	16#0 = Absolute mode P3 -> P4
14	VAR_EXTER	bEmergencyStop	BOOL	FALSE	
15	VAR_CONST	iDT_HSC	INT	52	
16	VAR	wHSC_Ch0_Clear	WORD	16#8	
17	VAR	wHSC_Ch0_NoSoftR	WORD	16#0	No software reset, Ch0
18	VAR	wHSC_Ch2_Clear	WORD	16#2008	
19	VAR	wHSC_Ch2_NoSoftR	WORD	16#2000	No software reset, Ch2

LD Body



☛ next page


9
Positioning done
bCircInterpFlag
N
bFromP4toP1Start
bPosOperDone
bEmergencyStop
10
Emergency Stop!
Clear Ch0 and Ch2, no software reset Ch0 and Ch2.
bEmergencyStop
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch0_Clear
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch0_NoSoftR
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch2_Clear
Any16
Flag
iDT_HSC
Offs*
E_Any16_ToSpecDT
EN
ENO
wHSC_Ch2_NoSoftR
Any16
Flag
iDT_HSC
Offs*

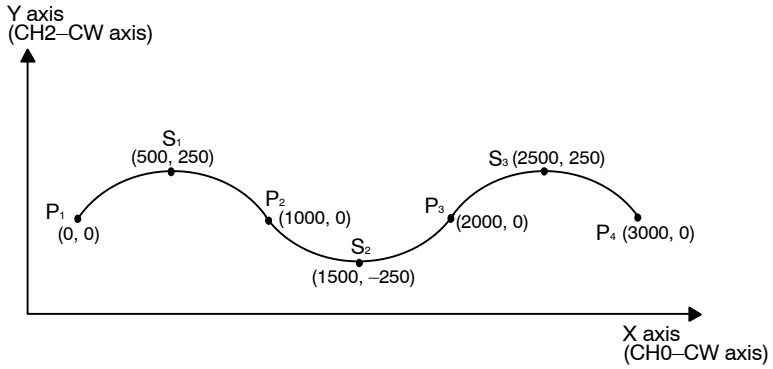
7.4.6.4 Continue Mode Method

Example program

This is an example program that continually executes the circular interpolation action.

Start the first point P1 (0, 0), overwrite the target value three times, and move to final position P4.

To overwrite the data after startup, use the special internal relay R904F and a shift register.



– I / O Allocation

I / Onumber	Description	I / Onumber	Description
XB	Positioning start	**R903A**	Control flag (CH0)
R0	Positioning running	**R903C**	Control flag (CH2)
R1	Positioning done	**R904E**	Circular interpolation control flag
R10*	Data setting for the controlfrom P1 to P2	**R904F**	Set value change confirmation flag
R11*	Data setting for the controlfrom P2 to P3		
R12*	Data setting for the controlfrom P3 to P4		
R13*	Mode changing for stoppage		

*R10 to R13 are used by shift register.

– Allocation of data registers

Item	Data register number	Description	Details
User setting area	DT1000 to 1001	Control code	Continue mode, Absolute, Pass position setting method
	DT1002 to 1003	Composite speed	1000Hz
	DT1004 to 1005	Target position (X–axis)	Target position (X–axis) P2, P3 and P4
	DT1006 to 1007	Target position (Y–axis)	Target position (Y–axis) P2, P3 and P4
	DT1008 to 1009	Pass position (X–axis)	Target position (X–axis) S1, S2 and S3
	DT1010 to 1011	Pass position (Y–axis)	Target position (Y–axis) S1, S2 and S3
Work area	DT1012 to 1017	Operation result storage area	Parameters calculated due to instruction execution are stored
Elapsed value area	DT90044 to 90045	Elapsed value area (CH0)	Current position (X–axis) : 0
	DT90200 to 90201	Elapsed value area (CH2)	Current position (Y–axis) : 0

– Sample program

Key Points:

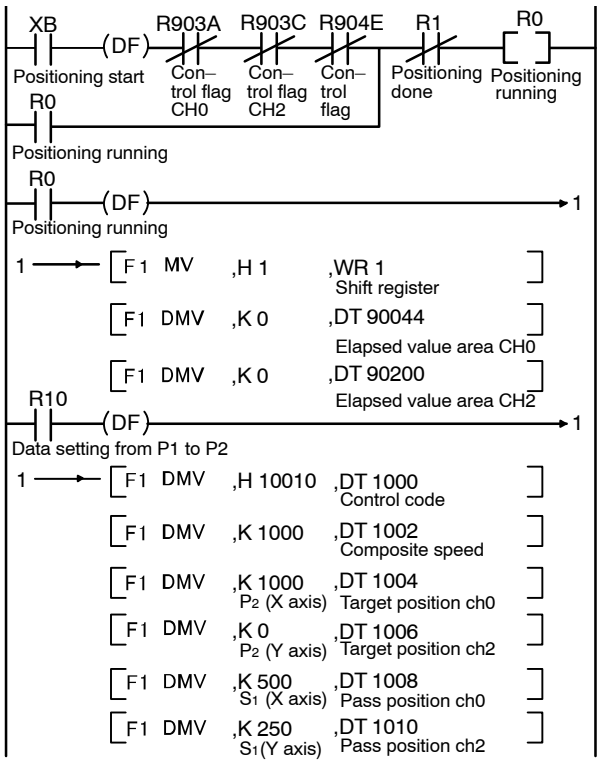
–To overwrite the data after startup use the circular interpolation data overwrite permission flag R904F.

–In control that heads toward final point P4, designate by switching the control code to the stop mode.

–In this example, since the rotation direction changes for each positioning point, designation of the control code rotation direction is as follows.

1) Between P1 and P2: FromCH2–CW to CH0–CW direction
2) Between P2 and P3: FromCH0–CW to CH2–CW direction
3) Between P3 and P4: FromCH2–CW to CH0–CW direction

FPWIN GR:



Positioning start

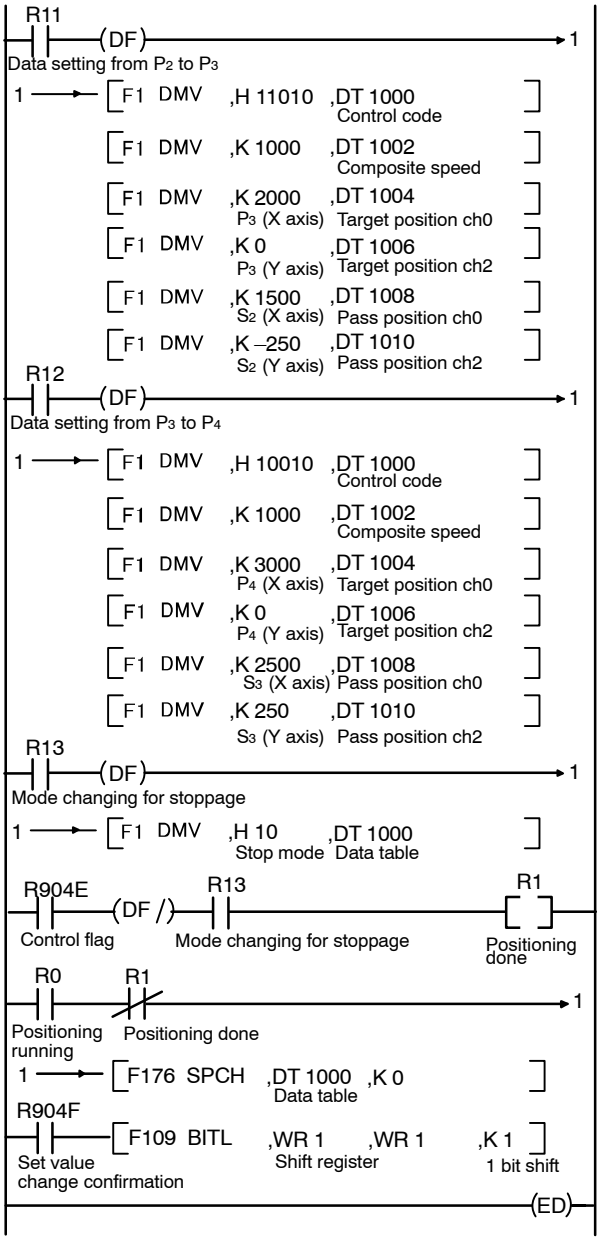
– In case of R903A, R903C and R904E are OFF, if XB turns ON, positioning is started.

Data preset

– Shift register preset.
– Elapsed value area preset.

Data setting for the control from P_1 to P_2

– Control code
Continue mode from CH2–CW to CH0–CW direction
Pass position setting method
Absolute
– Composite speed: 1000Hz
– Target position : P2 (1000, 0)
– Pass position : S1 (500, 250)



Data setting for the control from P_2 to P_3

– Control code
Continue mode from CH0–CW to CH2–CW direction
Pass position setting method
Absolute
– Composite speed: 1000Hz
– Target position : P3 (2000, 0)
– Pass position : S2 (1500, –250)

Data setting for the control from P_3 to P_4

– Control code
Continue mode from CH2–CW to CH0–CW direction
Pass position setting method
Absolute
– Composite speed: 1000Hz
– Target position : P4 (3000, 0)
– Pass position : S3 (2500, 250)

Mode changing for stoppage

– Control code: Stop mode

Positioning done

Circular interpolation start

1 bit shift

FPWIN Pro:

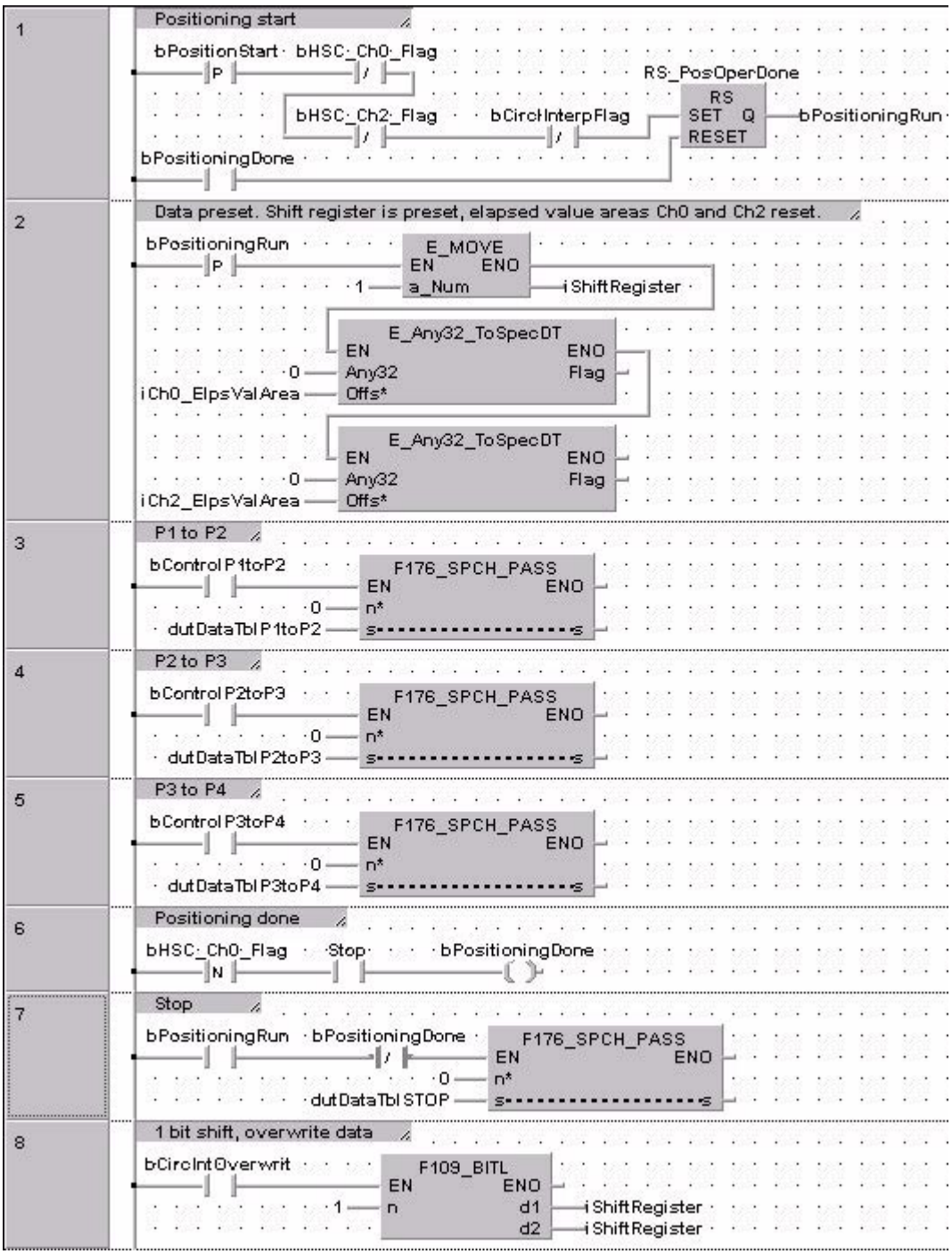
GVL

	Class	Identifier	Matsus	IEC_Address	Type	Initial
0	VAR_GLOBAL	bPositionStart	XB	%IX0.11	BOOL	FALSE
1	VAR_GLOBAL	bEmergencyStop	XC	%IX0.12	BOOL	FALSE
2	VAR_GLOBAL	bHSC_Ch0_Flag	R903A	%MX0.903.10	BOOL	FALSE
3	VAR_GLOBAL	bHSC_Ch2_Flag	R903C	%MX0.903.12	BOOL	FALSE
4	VAR_GLOBAL	bCirclInterpFlag	R904E	%MX0.904.14	BOOL	FALSE
5	VAR_GLOBAL	bCirclntOverwrit	R904F	%MX0.904.15	BOOL	FALSE
6	VAR_GLOBAL	iShiftRegister	WR1	%MW0.1	INT	0

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTER	bPositionStart	BOOL	FALSE	
1	VAR_EXTER	bHSC_Ch0_Flag	BOOL	FALSE	
2	VAR_EXTER	bHSC_Ch2_Flag	BOOL	FALSE	
3	VAR_EXTER	bCirclInterpFlag	BOOL	FALSE	
4	VAR	RS_PosOperDone	RS		
5	VAR_EXTER	iShiftRegister	INT	0	
6	VAR_EXTER	bCirclntOverwrit	BOOL	FALSE	
7	VAR	bPositioningRun	BOOL	FALSE	
8	VAR_CONST	iCh0_ElpsValArea	INT	44	HSC Ch0 Elapsed Value Area
9	VAR_CONST	iCh2_ElpsValArea	INT	200	HSC Ch2 Elapsed Value Area
10	VAR	bControlP1toP2	BOOL	FALSE	
- 11	VAR	dutDataTblP1toP2	PULSE_ARC_PASS	Control Code := 16#10010, Speed := 1000, TargetPos_X := 1000, TargetPos_Y := 0, PassPos_X := 500, PassPos_Y := 250	
12	VAR	bControlP2toP3	BOOL	FALSE	
- 13	VAR	dutDataTblP2toP3	PULSE_ARC_PASS	Control Code := 16#11010, Speed := 1000, TargetPos_X := 2000, TargetPos_Y := 0, PassPos_X := 1500, PassPos_Y := -250	
14	VAR	bControlP3toP4	BOOL	FALSE	
- 15	VAR	dutDataTblP3toP4	PULSE_ARC_PASS	Control Code := 16#10010, Speed := 1000, TargetPos_X := 3000, TargetPos_Y := 0, PassPos_X := 2500, PassPos_Y := 250	
16	VAR	Stop	BOOL	FALSE	
17	VAR	dutDataTblSTOP	PULSE_ARC_PASS	Control Code := 16#10	
18	VAR	bPositioningDone	BOOL	FALSE	

LD Body


1
Positioning start
bPositionStart
P
bHSC_Ch0_Flag
/
RS_PosOperDone
bHSC_Ch2_Flag
/
bCircInterpFlag
/
RS
SET Q
RESET
bPositioningRun
bPositioningDone
2
Data preset. Shift register is preset, elapsed value areas Ch0 and Ch2 reset.
bPositioningRun
P
E_MOVE
EN ENO
1
a_Num
iShiftRegister
E_Any32_ToSpecDT
EN ENO
0
Any32
Flag
iCh0_ElpsValArea
Offs*
E_Any32_ToSpecDT
EN ENO
0
Any32
Flag
iCh2_ElpsValArea
Offs*
3
P1 to P2
bControlP1toP2
F176_SPCH_PASS
EN ENO
0
n*
dutDataTblP1toP2
s
s
4
P2 to P3
bControlP2toP3
F176_SPCH_PASS
EN ENO
0
n*
dutDataTblP2toP3
s
s
5
P3 to P4
bControlP3toP4
F176_SPCH_PASS
EN ENO
0
n*
dutDataTblP3toP4
s
s
6
Positioning done
bHSC_Ch0_Flag
N
Stop
bPositioningDone
7
Stop
bPositioningRun
bPositioningDone
/
F176_SPCH_PASS
EN ENO
0
n*
dutDataTblSTOP
s
s
8
1 bit shift, overwrite data
bCircIntOverwrit
F109_BITL
EN ENO
1
n
d1
iShiftRegister
d2
iShiftRegister

7.5 PWM Output Function

With the **F173 (PWMH)** instruction, the pulse width modulation output of the specified duty ratio is obtained. When using the PWM output function, set the channels CH0 and CH2 with system registers 400 and 401 to “High–speed counter (HSC) not used” (FPWIN Pro)/“Do not use high–speed counter” (FPWIN GR).

7.5.1 PWM Output Instruction F173

While X6 (MotorSwitch) is in the ON state, a pulse with a period of 502.5ms and duty ratio of 50% is output from Y0 of the specified channel CH2.

When the program is run, the data table will be as shown below.

Data table

DT100	Control code *1	:K 1
DT101	Duty *2	:50%

*1: Specify the control code by setting the K constant.

Resolution of 1000

K	Frequency (Hz)	Period (ms)
K0	1.5	666.7
K1	2.0	502.5
K2	4.1	245.7
K3	6.1	163.9
K4	8.1	122.9
K5	9.8	102.4
K6	19.5	51.2
K7	48.8	20.5
K8	97.7	10.2
K9	201.6	5.0
K10	403.2	2.5
K11	500.0	2.0
K12	694.4	1.4
K13	1.0 k	1.0
K14	1.3 k	0.8
K15	1.6 k	0.6
K16	2.1 k	0.5
K17	3.1 k	0.3
K18	6.3 k	0.2
K19	12.5 k	0.1

Resolution of 100

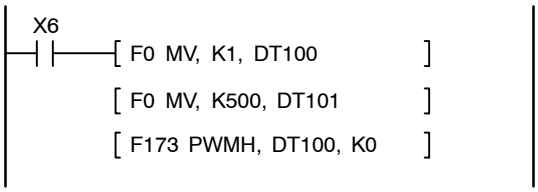
K	Frequency (Hz)	Period (ms)
K20	15.6 k	0.06
K21	20.8 k	0.05
K22	25.0 k	0.04
K23	31.3 k	0.03
K24	41.7 k	0.02

*2: Specification of duty (specify using K constant)
If the control code is K0 to K19, the duty is K0 to K999 (0.0% to 99.9%).
If the control code is K20 to K24, the duty is K0 to K990 (0% to 99%).
Values are specified in units of 1% (K10) (digits behind the decimal point are rounded off).

Note

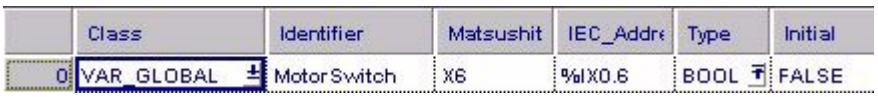
If a value outside the specified range is written to the duty area while the instruction is being executed, a frequency corrected to the maximum value is output. If written when instruction execution is started, an operation error is occured.

FPWIN GR:

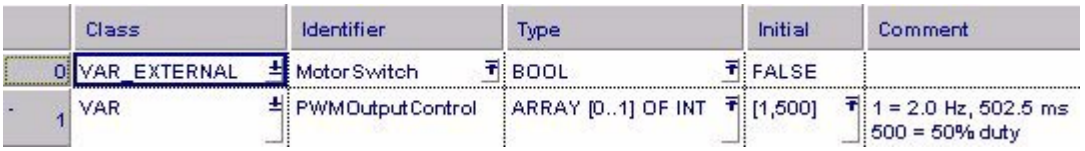


FPWIN Pro:

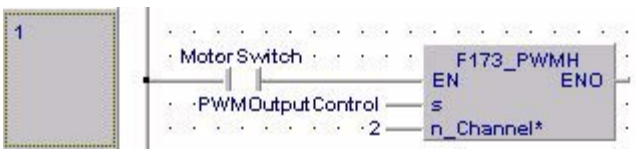
GVL



POU Header



LD Body



Chapter 8

Communication Cassette

8.1 Communication Modes of the FPΣ

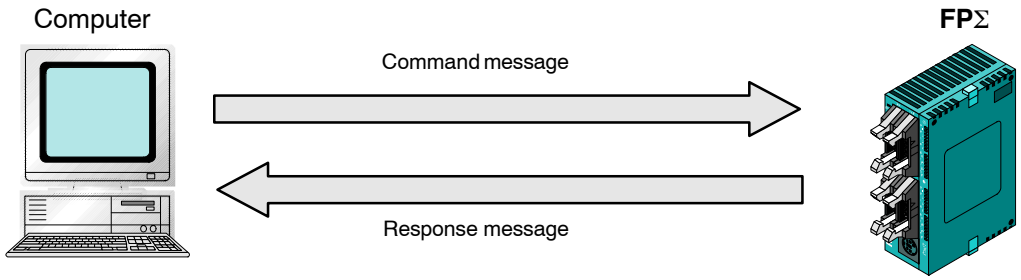
With the optional communication cassette, the FPΣ offers three different communication modes: computer link, general–purpose serial communication, and PLC link.

8.1.1 Computer Link

Computer link (see also chapter 9) is used for communication with a computer connected to the PLC. Instructions (command messages) are transmitted to the PLC, and the PLC responds (sends response messages) based on the instructions received.

A proprietary MEWNET protocol called MEWTOCOL–COM is used to exchange data between the computer and the PLC. There are two different communication methods: 1:1 and 1:N communication. A 1:N network is called a C–NET.

The PLC answers automatically to the commands received from the computer, so no program is necessary on the PLC side in order to carry out communication.



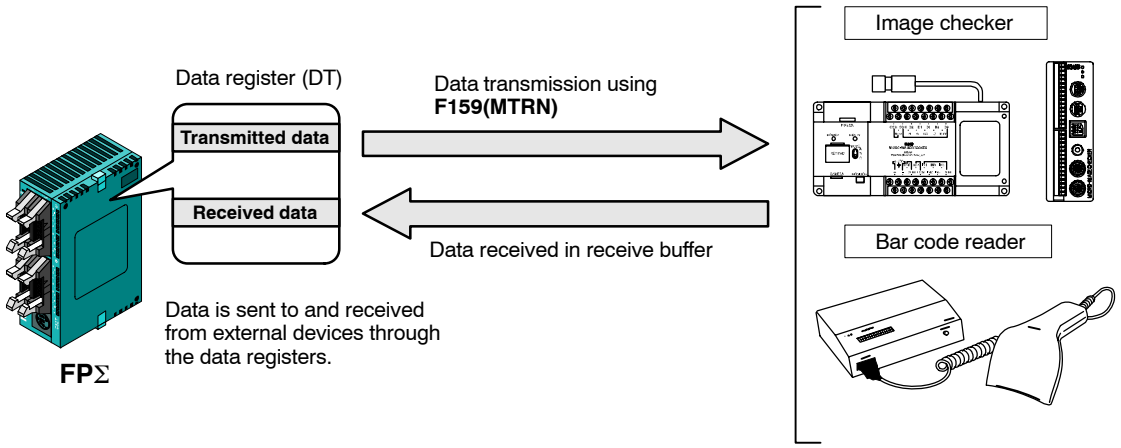
Applicable communication cassette

For 1:1 communication: 1–channel RS232C type (part no. FPG–COM1)
2–channel RS232C type (part no. FPG–COM2)
For 1:N communication: 1–channel RS485 type (part no. FPG–COM3)

8.1.2 General–Purpose Serial Communication

With general–purpose serial communication (see also chapter 10), data can be sent back and forth between an image processing device connected to the COM port and an external device such as a bar code reader.

A program in the FPΣ is required to send and to receive data. The data to be transmitted and the data received is stored in data registers specified by system register settings.



Applicable communication cassette

For 1:1 communication: 1–channel RS232C type (part no. FPG–COM1)
2–channel RS232C type (part no. FPG–COM2)
For 1:N communication: 1–channel RS485 type (part no. FPG–COM3)

8.1.3 PLC Link

In a PLC link (see also chapter 11), data is shared with all PLCs connected via MEWNET using dedicated internal relays called link relays (L) and data registers called link registers (LD).

If the link relay contact for one PLC goes on, the same link relay also goes on in each of the other PLCs connected to the network. Likewise, if the contents of a link register are rewritten in one PLC, the change is made in the same link register of each of the other PLCs connected to the network.

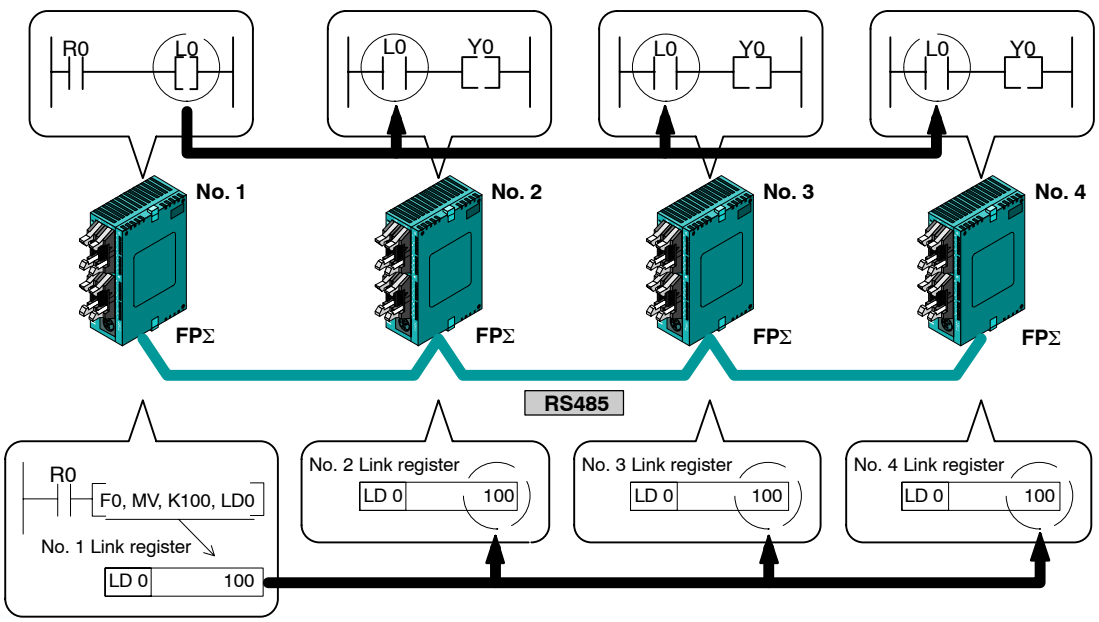
The status of the link relays and link registers in any one PLC is fed back to all of the other PLCs connected to the network, so control of data that needs to be consistent throughout the network, such as target production values and type codes, can easily be implemented to coordinate the data, and the data of all units are updated at the same time.

Link relay

In the figure below, when link relay L0 of the master station (no. 1) turns on, this signal is converted by the programs of the other stations, and Y0 of the other stations is activated.

Link register

In the figure below, if a constant of 100 is written to LD0 of the master station (no. 1), the contents of LD0 in the other stations are also changed to a constant of 100.



Applicable communication cassette

For 1:N communication: 1–channel RS485 type (part no. FPG–COM3)

8.2 Device Description

This section describes the different cassette types available and the main applications of the COM ports. It also contains the specifications of the different communication modes.

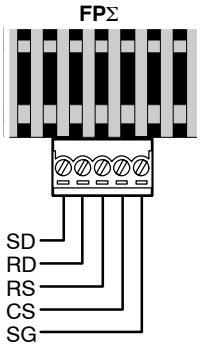
8.2.1 Cassette Types

There are three types of communication cassettes, each having a particular field of application:

1–channel RS232C type (part no. FPG–COM1)

This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.

Terminal layout



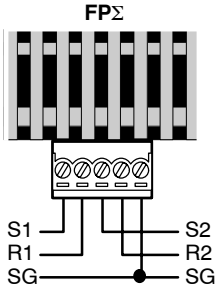
Abbreviation	Name	Signal direction
SD	Transmitted data	Unit →External device
RD	Received data	Unit ←External device
RS	Request to Send	Unit →External device
CS	Clear to Send	Unit ←External device
SG	Signal Ground	—

When a 1–channel type cassette is used, the COM.2 communications status display LED is as follows:
"S": Always on
"R": On when RS and CS terminals connected

2–channel RS232C type (part no. FPG–COM2)

This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication.
Communication with two external devices is possible.

Terminal layout

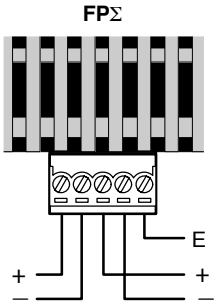


Abbreviation	Name	Signal direction
S1	Transmitted data 1	Unit →External device
R1	Received data 1	Unit ←External device
S2	Transmitted data 2	Unit →External device
R2	Received data 2	Unit ←External device
SG	Signal Ground	—

1–channel RS485 type (part no. FPG–COM3)

This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1:N computer links and general–purpose serial communication.

Terminal layout



Abbreviation	Name	Signal direction
+	Transmission line (+)	—
–	Transmission line (–)	—
+	Transmission line (+)	—
–	Transmission line (–)	—
E	Terminal station setting	—

8.2.2 COM Ports

The Tool port provided as a standard feature of the FPΣ is treated as COM port 0. The ports on the communication cassette are treated as COM port 1 and COM port 2. The principle applications of the various ports are described below.

Port name	No communication cassette installed	1–channel RS232C type installed	2–channel RS232C type installed	1–channel RS485 type installed
COM port 0	Tool port Computer link	Tool port Computer link	Tool port Computer link	Tool port Computer link
COM port 1	—	Computer link General–purpose	Computer link General–purpose	Computer link General–purpose PLC link
COM port 2	—	—	Computer link General–purpose	—

Notes

- **MEWTOCOL–COM can be used on all ports which support computer link. With MEWTOCOL–COM, the same commands are supported on all three channels, and frames of up to 2,048 bytes (header “<”) are possible.**
- **General–purpose serial communication is only possible on COM port 1 and COM port 2.**

8.2.3 Communication Specifications

1:1 serial communication (see note 1)

Item	Specification
Communication method	Half–duplex communication
Synchronous method	Start–stop synchronous system
Transmission line	RS232C
Transmission distance (Total length)	15 m/49.21 ft.
Transmission speed (Baud rate)	2,400 bit/s to 115.2 k bit/s (see note 2)
Transmission code	ASCII
Transmission data format	Stop bit: 1–bit/2–bit, parity: none/even/odd data length (character bits): 7–bit/8–bit (see note 2) Start codes: NOSTX/STX, end codes: CR/CR+LF/None/ETX
Interface	Conforming to RS232C (connection using terminal block)

Notes

1) For 1:1 serial communication, the RS232C type communication cassette is required. Additionally, re–send processing is recommended.

2) Transmission speed (baud rate) and transmission format are specified in the system registers.

1:N serial communication (see note 1)

Item	Specification
Communication method	Two–wire half–duplex communication
Synchronous method	Start–stop synchronous system
Transmission line	Twisted pair cable or VCTF
Transmission distance (Total length)	Max. 1,200 m/3,937 ft. (see notes 4 and 5)
Transmission speed (Baud rate)	2,400 bit/s to 115.2 k bit/s (19,200 bit/s when a C–NET adapter is connected) (see notes 2, 4 and 5)
Transmission code	ASCII
Transmission data format	Stop bit: 1–bit/2–bit, parity: none/even/odd data length (character bits): 7–bit/8–bit (see note 2) Start codes: NOSTX/STX, end codes: CR/CR+LF/None/ETX
Number of units (stations)	Max. 99 units (stations) (max. 32 units (stations) when a C–NET adapter is connected) (see notes 3, 4 and 5)
Interface	Conforming to RS485 (connection using terminal block)

Notes

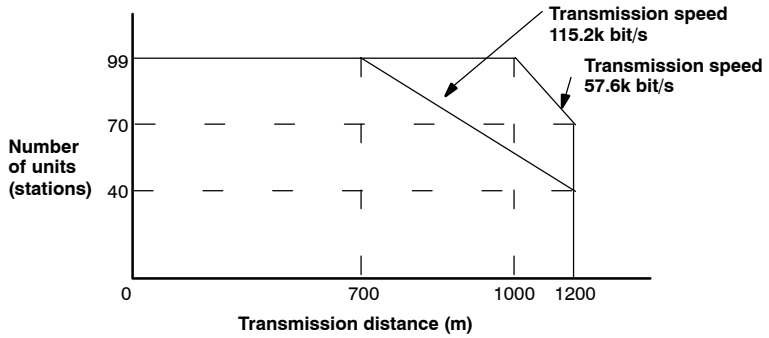
1) For 1:N serial communication, the RS485 type communication cassette is required. Additionally, re–send processing is recommended.

2) Transmission speed (baud rate) and transmission format are specified in the system registers.

3) Unit (station) numbers are specified in the system registers. Up to 31 units (stations) can be specified using the switches on the control unit.

4) When connecting a commercially available device having an RS485 interface, please confirm operation using the actual device. In some cases, the number of units (stations), transmission distance, and transmission speed (baud rate) vary depending on the connected device.

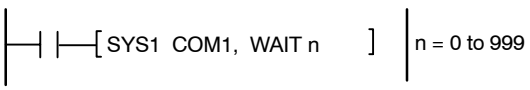
5) The values for transmission distance, transmission speed (baud rate), and number of units (stations) should be within the ranges shown in the diagram below.

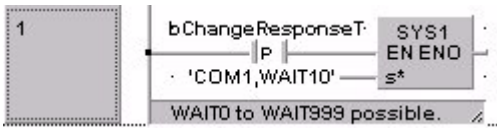


When using a transmission speed of 2,400 bit/s to 38.4k bit/s, a maximum of 99 units (stations) and a maximum transmission distance of 1,200 m are possible.

Tip

The FPΣ provides a SYS instruction, which can be used to change the time between when an instruction is received, and a response returned.
SYS1 instruction: Delay response by scan time ”n”.





PLC link function (see note 1)

Item	Specification
Communication method	Token bus
Transmission method	Floating master
Transmission line	Twisted pair cable or VCTF
Transmission distance (Total length)	1,200 m/3,937 ft.
Transmission speed (Baud rate)	115.2 k bit/s
Number of units (stations)	Max. 16 units (stations) (see note 2)
PLC link capacity	Link relay: 1,024 points, link register: 128 words
Interface	Conforming to RS485 (connection using terminal block)

Notes

1) For PLC link, the RS485 type communication cassette is required.

2) Unit (station) numbers are specified using the switches on the control unit or the system registers.

8.3 Installation

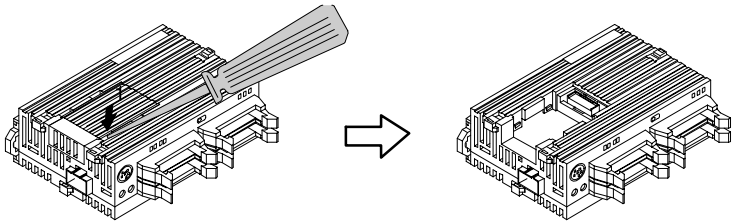
The communication cassette is easily attached to the FPΣ.

Note

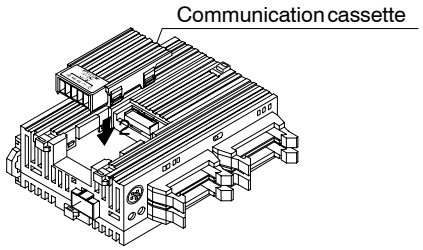
Turn off the power supply to the control unit before installing the communication cassette.

Procedure:

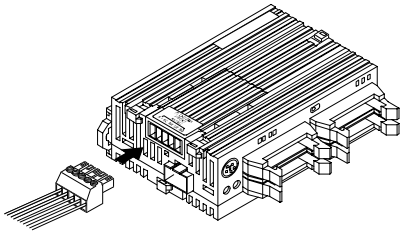
1. **Remove cover using screwdriver**



2. **Install communication cassette**

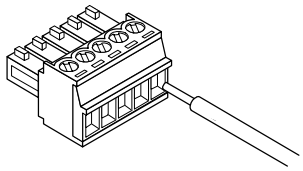


3. **Plug in communication connector**



8.4 Wiring

The communication cassette is supplied with a communication connector, which has a screw–type terminal block.



8.4.1 Wiring Equipment

Use the following items for wiring:

Accessory communication connector

If additional connectors are needed, use the communication connector manufactured by Phoenix Contact.

Number of pins	Phoenix Contact product ID	
	Model no.	Product no.
5 pins	MC1,5/5–ST–3,5	1840396

Suitable wire (twisted wire)

Size	Cross–sectional area
AWG#28 to 16	0.08 mm^2 to 1.25 mm^2

Pole terminals with compatible insulation sleeve

If you wish to use pole terminals, Phoenix Contact offers the following models:

Manufacturer	Cross-sectional area	Size	Product number
Phoenix Contact	0.25 mm^2	AWG#24	AI 0,25–6 YE
	0.50 mm^2	AWG#20	AI 0,50–6 WH
	0.75 mm^2	AWG#18	AI 0,75–6 GY
	1.00 mm^2	AWG#18	AI 1–6 RD

Pressure welding tool for pole terminals

Manufacturer	Phoenix Contact product ID	
	Model no.	Product no.
Phoenix Contact	CRIMPFOX UD6	12 04 43 6

Screwdriver for terminal block

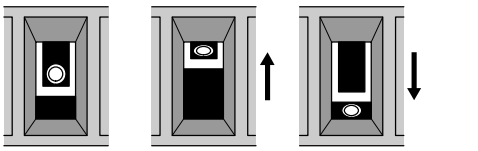
To tighten the terminals of the communication connector, use a screwdriver by Phoenix Contact, product no. 1205037, blade size 0.4 x 2.5, model no. SZS 0,4 x 2,5. The tightening torque should be 0.22 to 0.25 Nm or less.

8.4.2 Wiring Method

When wiring the communication cassette, the following items should be observed, taking care not to cut or disconnect the wiring.

Notes

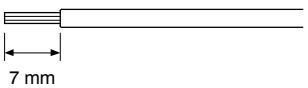
- **When removing the wire's insulation, be careful not to scratch the core wire.**
- **Do not twist the wires to connect them.**
- **Do not solder the wires to connect them. The solder may break due to vibration.**
- **After wiring, make sure stress is not applied to the wire.**
- **In the terminal block socket construction, if the wire is fastened upon counter-clockwise rotation of the screw, the connection is faulty. Disconnect the wire, check the terminal hole, and then re-connect the wire.**



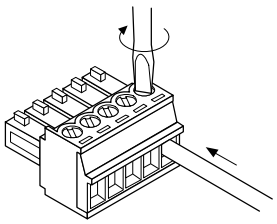
CORRECT (Clockwise) **INCORRECT** (Counter clockwise)

Procedure:

1. **Remove 7 mm/0.276 in. of the wire's insulation**



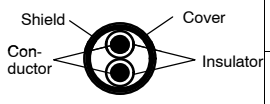
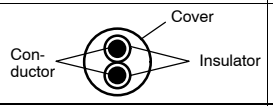
2. **Insert wire into terminal hole until it stops**
3. **Tighten screw clockwise to fix wire in place**



8.5 Cables

Please use the following cables for systems using RS485 type communication cassettes.

Appropriate Electrical Cables (standard wires)

Type	Cross–sectional view	Conductor		Insulator		Cable Diam.	Sample Appropriate Cable
		Size	Resistance (at 20°C)	Material	Thickness		
Shielded twisted pair		1.25 mm^2 (AWG16) or greater	Max. 16.8Ω/km	Polyethylene	Max. 0.5 mm	Approx 8.5mm	Belden 9860 Hitachi Cable, Ltd.KPEV–S1.25 mm^2 x 1P
		0.5 mm^2 (AWG20) or greater	Max. 33.4Ω/km	Polyethylene	Max. 0.5 mm	Approx 7.8mm	Belden 9207 Hitachi Cable, Ltd.KPEV–S0.5 mm^2 x 1P
VCTF		0.75 mm^2 (AWG18) or greater	Max. 25.1Ω/km	polychlorinated biphenyl	Max. 0.6 mm	Approx 6.6mm	VCTF–0.75 mm^2 x 2C(JIS)

Notes on Cable Use

Please use shielded twisted pair cables.

Please use only one type of transmission cable. Do not mix more than 1 type.

Twisted pair cables are recommended in noisy environments.

When using shielded cable with crossover wiring for the RS485 transmission line, ground one end.

Chapter 9

Computer Link

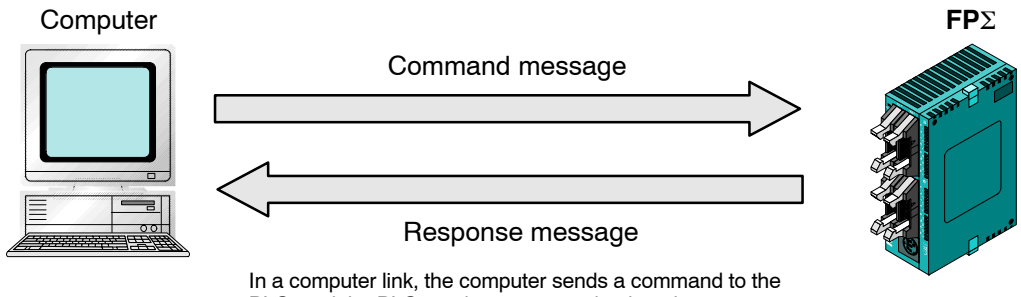
9.1 Overview

A computer link is a communication connection between a computer and a PLC, which allows monitoring and controlling the PLC operating status from a computer.

The computer and the PLC communicate via instructions (commands) from the computer to the PLC and response messages from the PLC to the computer.

A proprietary MEWNET protocol called MEWTOCOL–COM is used to exchange data between the computer and the PLC.

Communication speed and transmission format are specified in system registers no. 413 (COM port 1) and 414 (COM port 2).



In a computer link, the computer sends a command to the PLC, and the PLC sends a response back to the computer.

Program for computer link

For a computer link, a program must be written (e. g. in BASIC or C language) that enables the computer to send command messages and receive response messages. No communication program is required on the PLC side. Programs for the computer side must be based on the MEWTOCOL–COM format. MEWTOCOL–COM contains the commands used to monitor and control PLC operation.

9.1.1 Outline of Operation

Command and Response

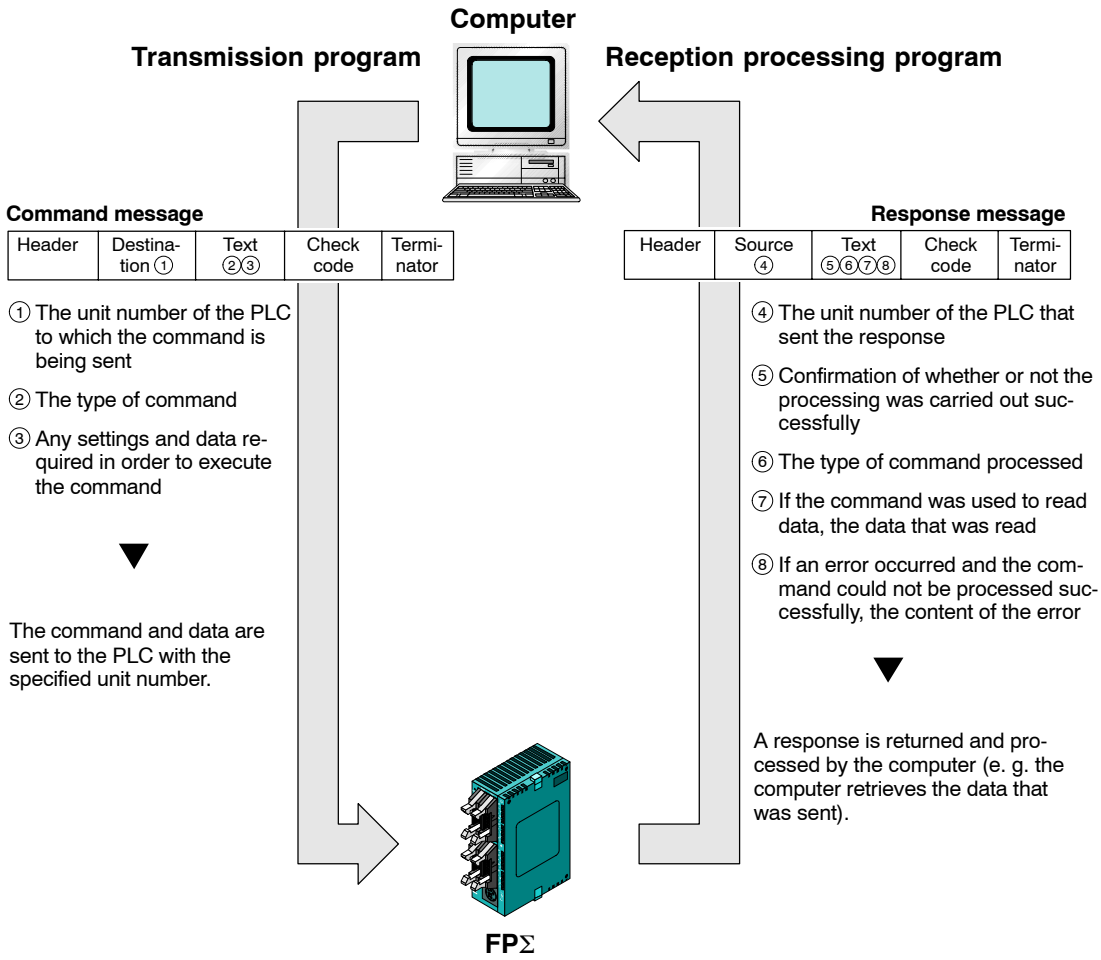
Instructions issued by the computer to the PLC are called commands. Messages sent back to the computer from the PLC are called responses. When the PLC receives a command, it processes the command regardless of the sequence program, and sends a response back to the computer.

MEWTOCOL–COM sketch

Communication is carried out in a conversational format, based on the MEWTOCOL–COM communication procedures.

Data is sent in ASCII format.

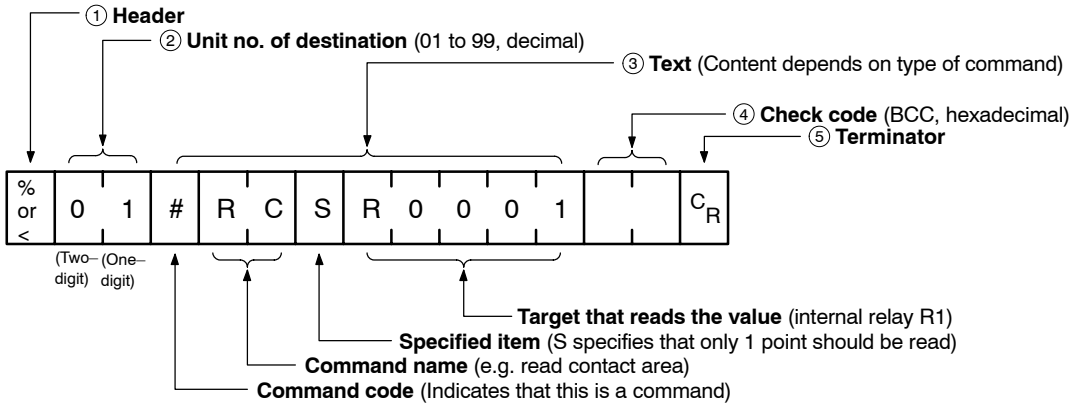
The computer has the first right of transmission. The right of transmission shifts back and forth between the computer and the PLC each time a message is sent.


Computer
Transmission program
Reception processing program
Command message
Header
Destination ①
Text ②③
Check code
Terminator
① The unit number of the PLC to which the command is being sent
② The type of command
③ Any settings and data required in order to execute the command
The command and data are sent to the PLC with the specified unit number.
Response message
Header
Source ④
Text ⑤⑥⑦⑧
Check code
Terminator
④ The unit number of the PLC that sent the response
⑤ Confirmation of whether or not the processing was carried out successfully
⑥ The type of command processed
⑦ If the command was used to read data, the data that was read
⑧ If an error occurred and the command could not be processed successfully, the content of the error
A response is returned and processed by the computer (e. g. the computer retrieves the data that was sent).
FPΣ

9.1.2 Format of Command and Response

Command message

All command–related items should be noted in the text segment. The unit number must be specified before sending the command.


① Header
② Unit no. of destination (01 to 99, decimal)
③ Text (Content depends on type of command)
④ Check code (BCC, hexadecimal)
⑤ Terminator
% or <
0 1
#
R C
S
R 0 0 0 1
CR
(Two–digit)
(One–digit)
Target that reads the value (internal relay R1)
Specified item (S specifies that only 1 point should be read)
Command name (e.g. read contact area)
Command code (Indicates that this is a command)

① Header (start code)

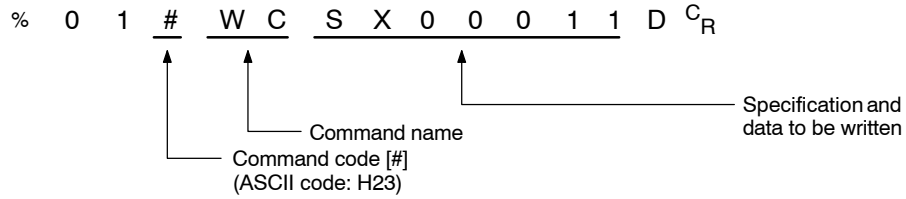
Commands must always have a "%" (ASCII code: H25) or a "<" (ASCII code: H3C) at the beginning of a message.

② Unit number

The unit number of the PLC to which you want to send the command must be specified. In 1:1 communication, the unit number "01" should be specified.

③ Text

The content differs depending on the command. The content should be noted in all upper–case characters, following the fixed formula for the particular command.



④ Check code

BCC (block check code) for error detection using horizontal parity. The BCC should be created so that it targets all of the text data from the header to the last text character.

The BCC starts from the header and checks each character in sequence, using the exclusive OR operation, and replaces the final result with character text. It is normally part of the calculation program and is created automatically.

The parity check can be skipped by entering "*** ***" (ASCII code: H2A2A) instead of the BCC.

⑤ Terminator (end code)

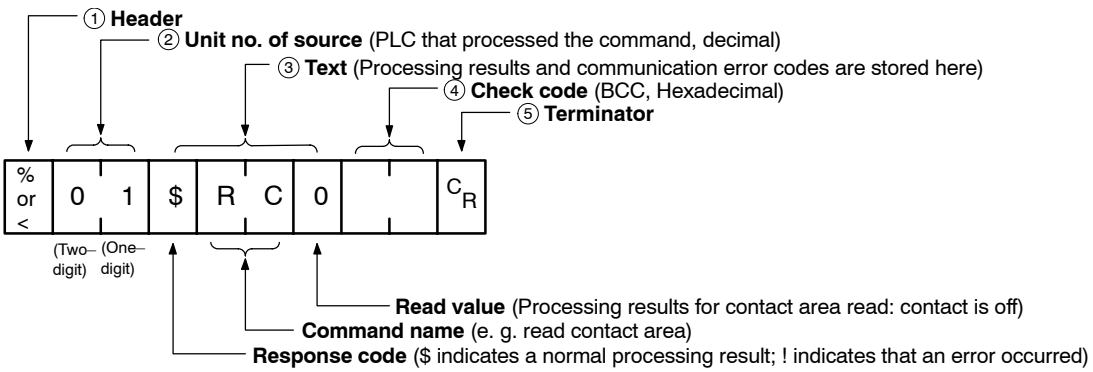
Messages must always end with a "C_R" (ASCII code: H0D).

Notes

- **The method for writing text segments in the message varies depending on the type of command.**
- **If there is a large number of characters to be written, they may be divided and sent as several commands. If there is a large number of characters in the value that was loaded, they may be divided and several responses sent.**

Response message

The PLC that received the command in the example above sends the processing results to the computer.


① Header
② Unit no. of source (PLC that processed the command, decimal)
③ Text (Processing results and communication error codes are stored here)
④ Check code (BCC, Hexadecimal)
⑤ Terminator
% or <
0 1
$
R C
0
CR
(Two–digit)
(One–digit)
Read value (Processing results for contact area read: contact is off)
Command name (e. g. read contact area)
Response code ($ indicates a normal processing result; ! indicates that an error occurred)

① Header (start code)

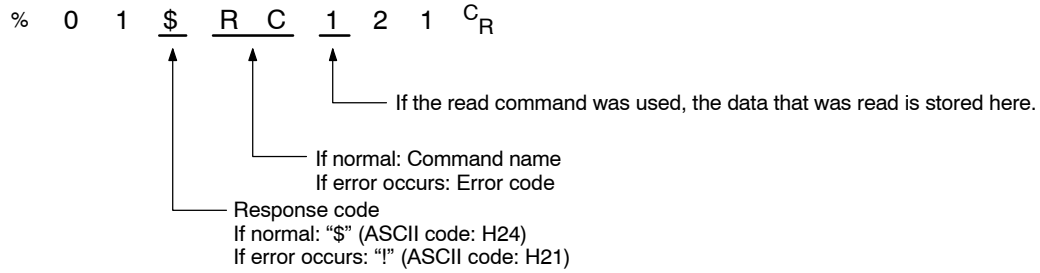
A “%” (ASCII code: H25) or “<” (ASCII code: H3C) must be at the beginning of a message. The response must start with the same header that was at the beginning of the command.

② Unit number

The unit number of the PLC that processed the command is stored here. In 1:1 communication, “01” will be stored here.

③ Text

The content of this varies depending on the type of command. The value should be read based on the content. If the processing is not completed successfully, an error code will be stored here, so that the content of the error can be checked.


% 0 1 $ R C 1 2 1 CR
If the read command was used, the data that was read is stored here.
If normal: Command name
If error occurs: Error code
Response code
If normal: “$” (ASCII code: H24)
If error occurs: “!” (ASCII code: H21)

④ Check code

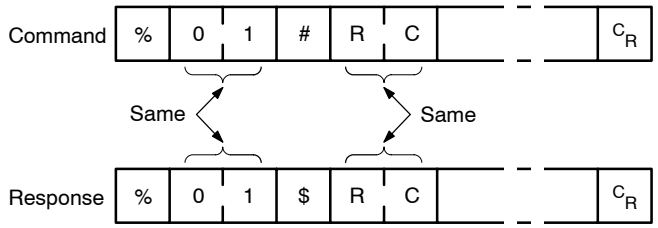
BCC (block check code) for error detection using horizontal parity. The BCC starts from the header and checks each character in sequence, using the exclusive OR operation, and replaces the final result with character text.

⑤ Terminator (end code)

There is always a “C_R” (ASCII code: H0D) at the end of the message.

Notes

- **If no response is returned, the command may not have arrived at the PLC, or the PLC may not be functioning. Check to make sure all of the communication specifications (e.g. baud rate, data length, and parity) match between the computer and the PLC.**
- **If the response contains an “!” instead of a “$”, the command was not processed successfully. The response will contain a communication error code. Check the meaning of the error code.**
- **Unit number and command name are always identical in a command and its corresponding response (see below). This makes the correspondence between a command and a response clear.**



9.1.3 Commands

Command name	Code	Description
Read contact area	RC (RCS) (RCP) (RCC)	Reads the on and off status of contacts. – Specifies only one point. – Specifies multiple contacts. – Specifies a range in word units.
Write contact area	WC (WCS) (WCP) (WCC)	Turns contacts on and off. – Specifies only one point. – Specifies multiple contacts. – Specifies a range in word units.
Read data area	RD	Reads the contents of a data area.
Write data area	WD	Writes data to a data area.
Read timer/counter set value area	RS	Reads the value set for a timer/counter.
Write timer/counter set value area	WS	Writes a timer/counter setting value.
Read timer/counter elapsed value area	RK	Reads the timer/counter elapsed value.
Write timer/counter elapsed value area	WK	Writes the timer/counter elapsed value.
Register or Reset contacts monitored	MC	Registers the contact to be monitored.
Register or Reset data monitored	MD	Registers the data to be monitored.
Monitoring start	MG	Monitors a registered contact or data using MD and MC.
Preset contact area (fill command)	SC	Embeds the area of a specified range in a 16–point on and off pattern.
Preset data area (fill command)	SD	Writes the same contents to the data area of a specified range.
Read system register	RR	Reads the contents of a system register.
Write system register	WR	Specifies the contents of a system register.
Read the status of PLC	RT	Reads the specifications of the programmable controller and error codes if an error occurs.
Remote control	RM	Switches the operation mode of the programmable controller.
Abort	AB	Aborts communication.

Notes

- **Commands and responses used with the FPΣ have a dedicated header (start code) which has been added to the MEWTOCOL–COM communication protocol of the FP series PLCs.**
- **The content of the specified header varies depending on the communication conditions. With the FPΣ, in addition to ordinary MEWTOCOL–COM, an expansion header is supported to send single frames of up to 2,048 characters.**

Type of header	No. of characters that can be sent in 1 frame
%	Max. 118 characters
<	Max. 2048 characters

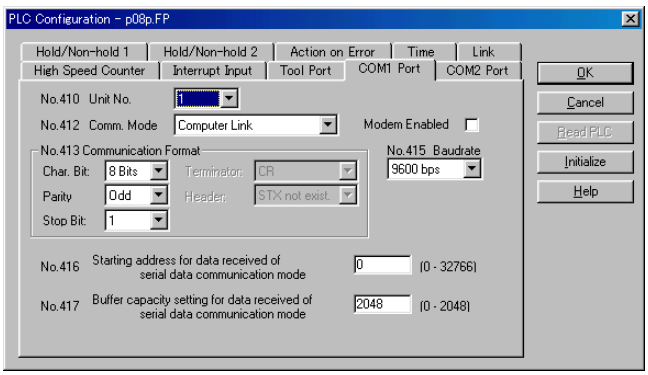
- **The number of characters that can be sent is limited by the type of header and the command.**

9.1.4 Setting Communication Parameters

By default, the COM port is set to computer link mode. For communication, system register settings should be entered for operation mode, communication format, baud rate, and receive buffer. The settings are entered using the FPWIN Pro or FPWIN GR programming tool.

Procedure for FPWIN GR:

1. **Options –> PLC Configuration**



2. **Select “COM. 1 Port” and “COM. 2 Port” tab**

   There are separate settings for COM. 1 and COM. 2.

   No. 412 Communication (Comm.) Mode

   Select the COM port operation mode: click on ▼, and select “Computer Link”.

   No. 413 (for COM.1 port), No. 414 (for COM.2 port) Communication Format setting

   Default settings:

Char. Bit	8 Bits
Parity	Odd
Stop Bit	1 Bit
Terminator	CR
Header	STX not exist

   To change the communication format to match an external device connected to the COM port, enter the settings for the various items.

   No. 415 Baud Rate (communication speed) setting

   The default setting for the communication speed for the various ports is 9600 bps.

   Change the value to match the external device connected to the COM port: click on ▼, and select one of the values from 2400 to 115200 bps.

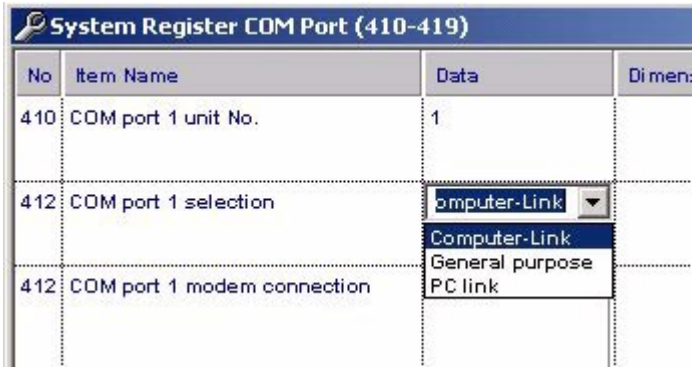
Procedure for FPWIN Pro:

1. **Double–click “PLC” in the project navigator**
2. **Double–click “System Register”**
3. **Double–click “COM Port”**

There are separate settings for COM ports 1 and 2.

No. 412: COM port 1 selection

Select the COM port operation mode: click on ▼, and select “Computer Link”.



No. 413 (for COM port 1), no. 414 (for COM port 2): communication format setting

Default settings:

Data length	8 Bits
Parity	Odd
Stop bit	1 Bit
Terminator	CR
Header	STX not exist

To change the communication format to match an external device connected to the COM port, enter the settings for the various items.

No. 415: baud rate

The default baud rate for the various ports is 9600 bps.

Change the value to match the external device connected to the COM port: click on ▼, and select one of the values from 2400 to 115200 bps.

Note

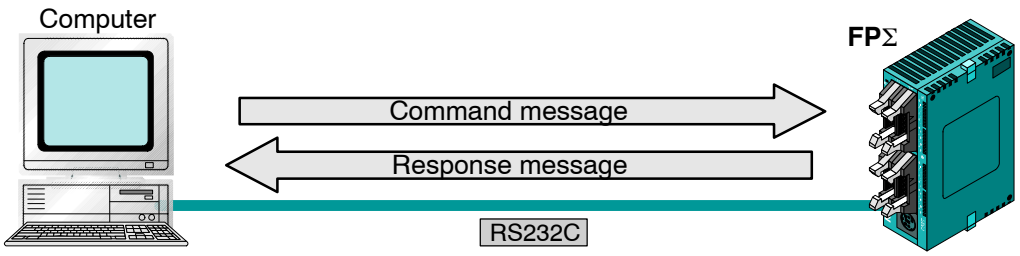
The two ports of the communication cassette can be used independently. They can be set to computer link mode or general–purpose serial communication.

9.2 Connection Examples

The following examples demonstrate how the PLC can be connected to an external device via a 1:1 computer link connection.

9.2.1 1:1 Communication With Computer

For a 1:1 computer link between the FPΣ and a computer, an RS232C cable is needed. Communication is performed via commands from the computer and responses from the PLC.



Communication cassette

The following types of communication cassettes can be used for 1:1 computer link communication.

Name	Description	Part no.
FPΣ communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

System register settings

For 1:1 communication using a computer link, the system registers should be set as shown below.

- Settings for COM port 1

No.	Name	Set value
No. 410	COM port 1 unit number	1
No. 412	COM port 1 selection of communication mode	Computer link
No. 413	Communication format for COM port 1	Data length: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . STX not exist
No. 415	Baud rate setting for COM port 1	9600 bps to 115200 bps

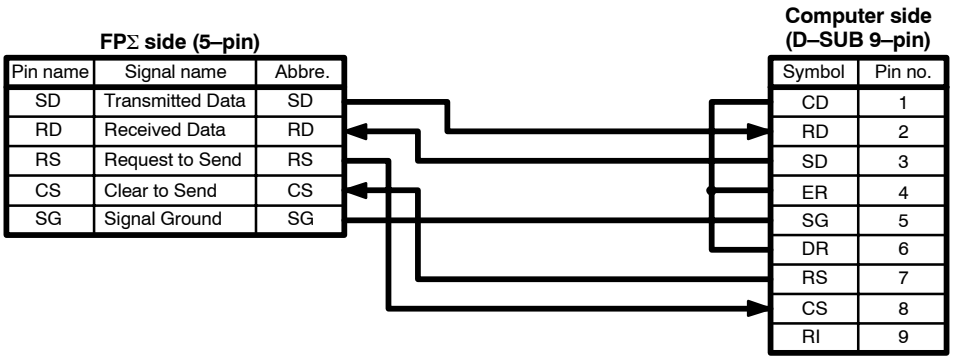
• Settings for COM port 2

No.	Name	Set value
No. 411	COM port 2 unit number	1
No. 412	COM port 2 selection of communication mode	Computer link
No. 414	Communication format for COM port 2	Data length: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . STX not exist
No. 415	Baud rate setting for COM port 2	9600 bps to 115200 bps

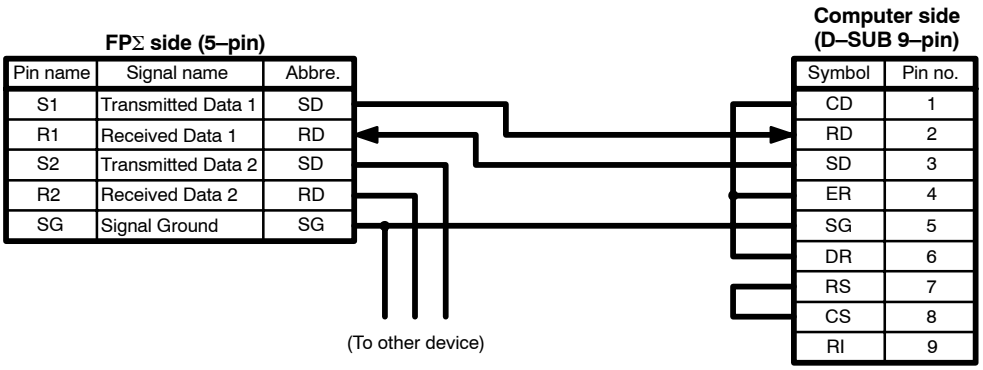
The communication format and baud rate (communication speed) should be set to match the connected computer.

Connection to the computer

• Using 1–channel RS232C type communication cassette



• Using 2–channel RS232C type communication cassette



Programming

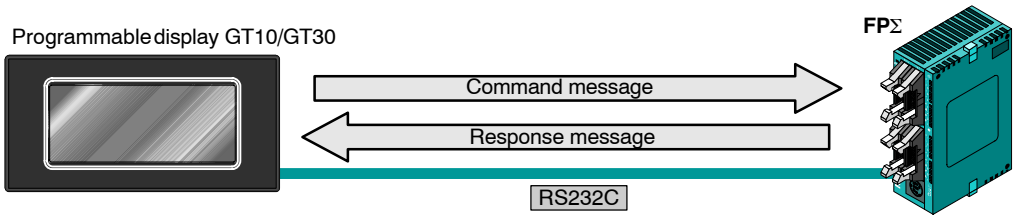
For a computer link, a program should be created that allows command messages to be sent and response messages to be received on the computer side. The PLC automatically sends back a response to a command. No communication program is required on the PLC side.

Also, if a software program such as PCWAY is used on the computer side, PLC data can easily be read and written without having to think about the MEWTOCOL–COM protocol.

9.2.2 1:1 Communication With Programmable Display GT10/GT30

A 1:1 computer link with a programmable display GT10/GT30 connects the FPΣ and the programmable display using an RS232C cable. Communication is performed via commands from the programmable display and responses from the PLC.

No program is required for communication. Simply set the mutual communications settings to operate the PLC via the programmable display.



Communication cassette

The following types of communication cassettes can be used for 1:1 computer link communication.

Name	Description	Part no.
FPΣ communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

System register settings for FPΣ

For 1:1 communication using a computer link, the system registers should be set as shown below.

- Settings for COM port 1

No.	Name	Set value
No. 410	COM port 1 unit number	1
No. 412	COM port 1 selection of communication mode	Computer link
No. 413	Communication format for COM port 1	Data length: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . STX not exist
No. 415	Baud rate setting for COM port 1	19200 bps

• Settings for COM port 2

No.	Name	Set value
No. 411	COM port 2 unit number	1
No. 412	COM port 2 selection of communication mode	Computer link
No. 414	Communication format for COM port 2	Data length: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . STX not exist
No. 415	Baud rate setting for COM port 2	19200 bps

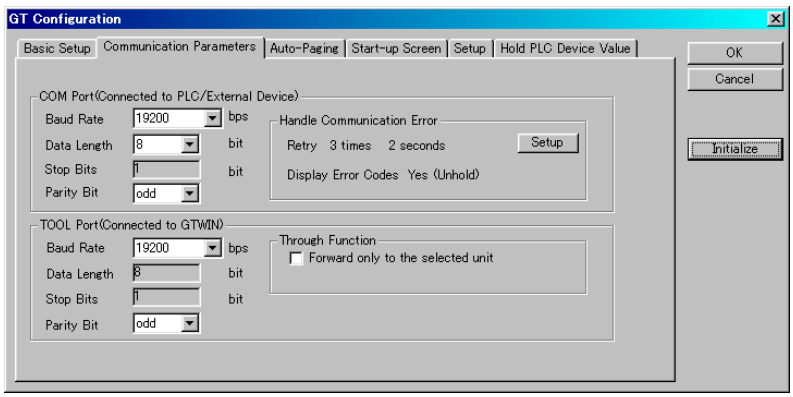
The communication format and baud rate (communication speed) should be set to match the connected programmable display.

Communication format settings for GT10/GT30

The factory communication format settings of the GT10/GT30 are as shown below. The GT configuration settings should be changed to match the application at hand.

Item	Description
Baud rate	19200 bps
Data length	8 bits
Stop bit	1 bit (fixed)
Parity bit	Odd

Communication condition settings are specified using the parameter settings for the GT10/GT30 and the “GT Configuration” item in the GTWIN screen creation tool. For detailed information, please see the technical manual for the GT10/GT30.



Connection to the programmable display GT10/GT30

• Using 1–channel RS232C type communication cassette:

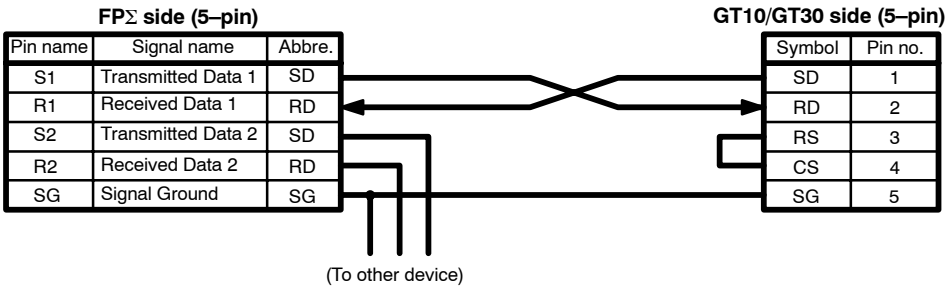
FPΣ side (5–pin)

Pin name	Signal name	Abbre.
SD	Transmitted Data	SD
RD	Received Data	RD
RS	Request to Send	RS
CS	Clear to Send	CS
SG	Signal Ground	SG

GT10/GT30 side (5–pin)

Symbol	Pin no.
SD	1
RD	2
RS	3
CS	4
SG	5

- Using 2–channel RS232C type communication cassette:



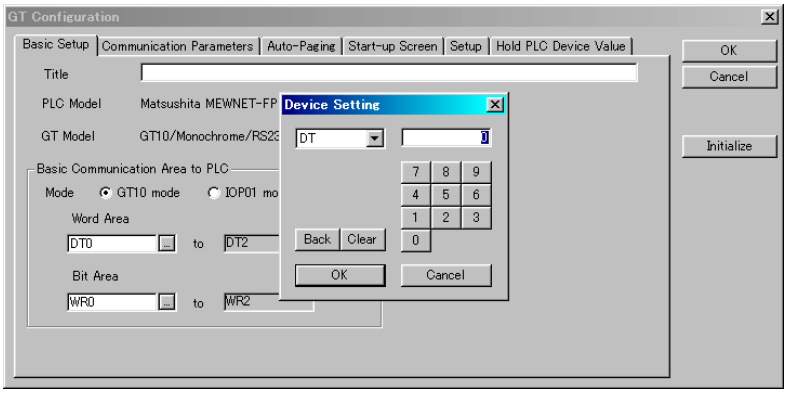
Basic communication area settings for GT10/GT30

To perform communication with a PLC, the data area reserved for communication must be set in the GT10/GT30.

The factory settings for the basic communication area of the GT10/GT30 are as shown below. The GT configuration settings should be changed to match the application at hand.

Item	Description
Word area	DT0 to DT2
Bit area	WR0 to WR2

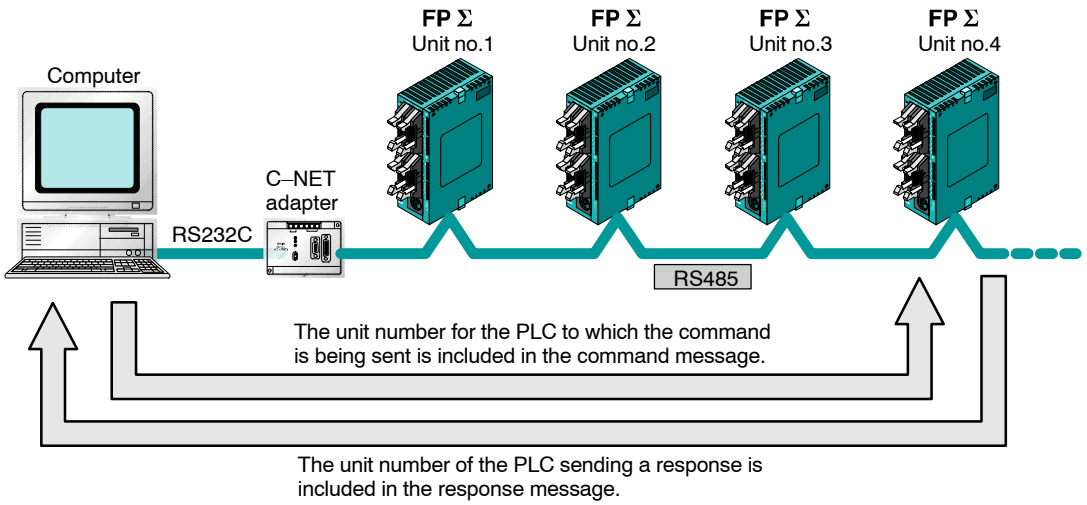
The basic communication area is changed using the configuration parameter settings for the programmable display and the “GT Configuration” dialog (“Basic Setup” tab) in the GTWIN screen creation tool.



9.3 1:N Communication

For a 1:N computer link, the computer and the FPΣ are connected through a commercially available RS232C–RS485 conversion adapter, and the respective PLCs are wired using an RS485 cable.

The computer and the PLC communicate via commands and responses: The computer sends a command specifying the unit number, and the PLC with that unit number sends a response back to the computer.



Note

If the FPΣ is used with a communication cassette (1–channel RS485 type), no C–NET adapter is necessary on the PLC side.

Communication Cassette

The following communication cassette can be used for 1:N computer link communication.

Name	Description	Part no.
FPΣ communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1:N computer links (C–NET), general–purpose serial communication, and a PLC link.	FPG–COM3

9.3.1 Setting System Registers and Unit Numbers

System registers

For 1:N communication using a computer link, the system registers should be set as shown below.

No.	Name	Set value
No.410	COM port 1 unit number	1 to 99 (Set the desired unit number)
No.412	COM port 1 selection of communication mode	Computer Link
No.413	Communication format for COM port 1	Data length: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . . 1 bit Terminator:. . . . . CR Header: . . . . . STX not exist
No.415	Baud rate setting for COM port 1	9600 bps

The communication format and baud rate (transmission speed) should be set to match the connected computer.

Note

When a C–NET adapter is used, the maximum number of units (stations) is 32.

Unit numbers (station numbers)

By default, the unit number for each communication port is set to 1 in the system register settings. There is no need to change this for 1:1 communication, but if 1:N communication is used to connect multiple PLCs to the transmission line (e.g. in a C–NET), the unit number must be specified so that the destination of the command can be identified.

The unit number is specified either by using the system register settings in the FPWIN Pro or FPWIN GR programming tool or the unit number setting switch on the side of the FPΣ control unit. Setting the unit number setting switch to 0 makes the system register settings valid, so that a unit number between 1 and 99 can be set.

- Setting unit numbers with the setting switch

The unit number setting switch is located underneath the cover on the left side of the FPΣ control unit. By setting the selector switch and the dial, a unit number between 1 and 31 can be set.

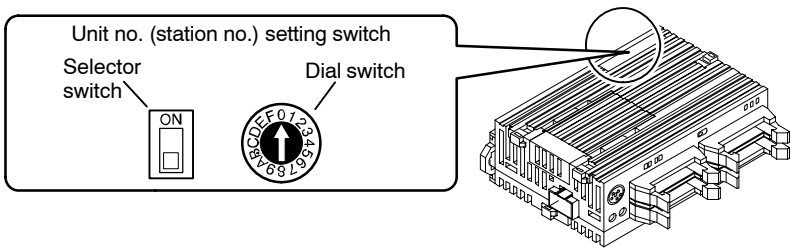


Table of switch settings and related unit numbers

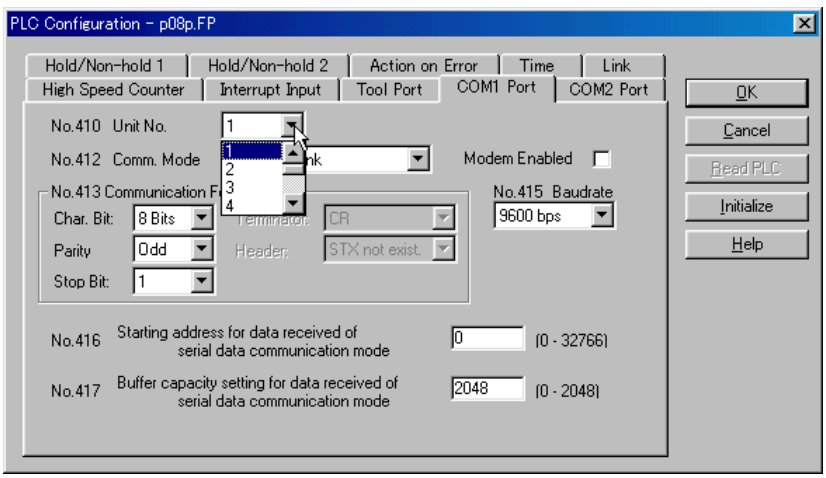
Dial switch position	Unit number	
	Selector switch: off	Selector switch: on
0	—	16
1	1	17
2	2	18
3	3	19
4	4	20
5	5	21
6	6	22
7	7	23
8	8	24
9	9	25
A	10	26
B	11	27
C	12	28
D	13	29
E	14	30
F	15	31

- Setting unit numbers with the programming software

To set unit numbers with the FPWIN Pro or FPWIN GR programming software, follow the procedure below.

Procedure for FPWIN GR:

1. Option –> PLC Configuration



2. Click “COM. Port” tab

No. 410 Unit no. setting (for COM.1 port), No.411 (for COM.2 port) Unit No. setting

Click on ▼, and select a unit number from 1 to 99.

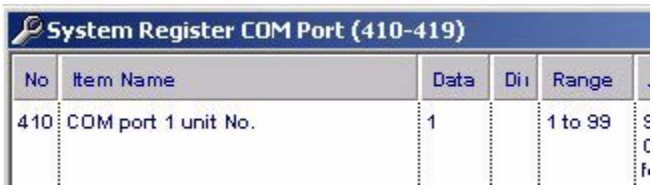
Procedure for FPWIN Pro:

1. **Double–click “PLC” in the project navigator**
2. **Double–click “System Register”**
3. **Double–click “COM Port”**

   There are separate settings for COM ports 1 and 2.

   No. 410 (for COM port 1): COM port unit no.

   Enter a unit number from 1 to 99.



Notes

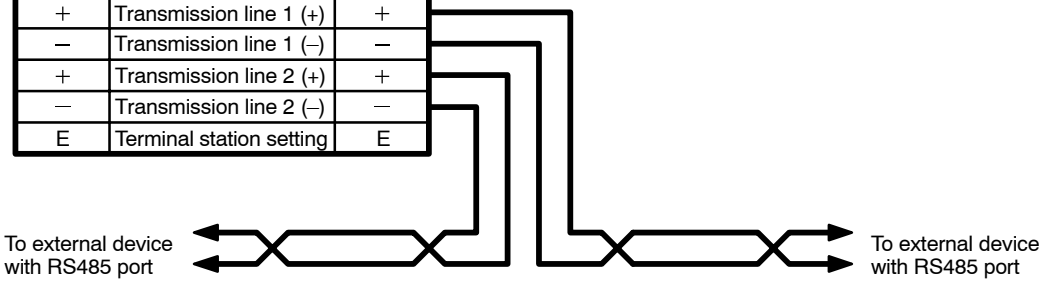
- **To enable the unit number setting in FPWIN Pro or FPWIN GR, set the unit number setting switch to 0.**
- **Unit numbers set using the unit number setting switch are valid only for the communication port of the communication cassette. Tool port unit numbers should be set using the system registers.**
- **With a C–NET adapter, a maximum of 32 units (stations) can be specified.**

9.3.2 Connection with External Devices

Connection diagram

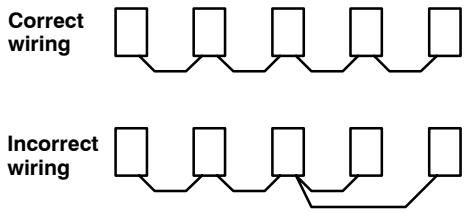
FPΣ side (5–pin)

Pin name	Signal name	Abbre.
+	Transmission line 1 (+)	+
–	Transmission line 1 (–)	–
+	Transmission line 2 (+)	+
–	Transmission line 2 (–)	–
E	Terminal station setting	E



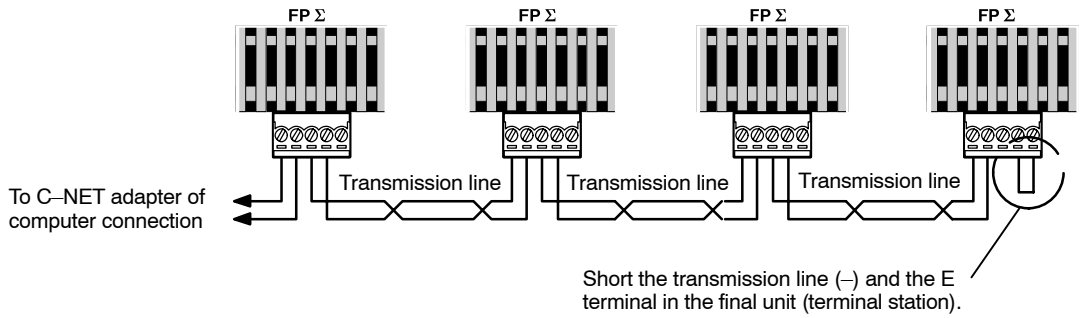
With 1:N communication, the various RS485 devices are connected using twisted pair cables. The (+) and (–) signals of transmission line 1 and transmission line 2 are connected inside the communication cassette, and either port may be used as COM port 1.

Wiring should extend from one unit to the next. Never run two wires from a single unit to two other units.



Setting of terminal station

In the PLC that serves as the final unit (terminal station), the transmission line (–) and the E terminal should be shorted.

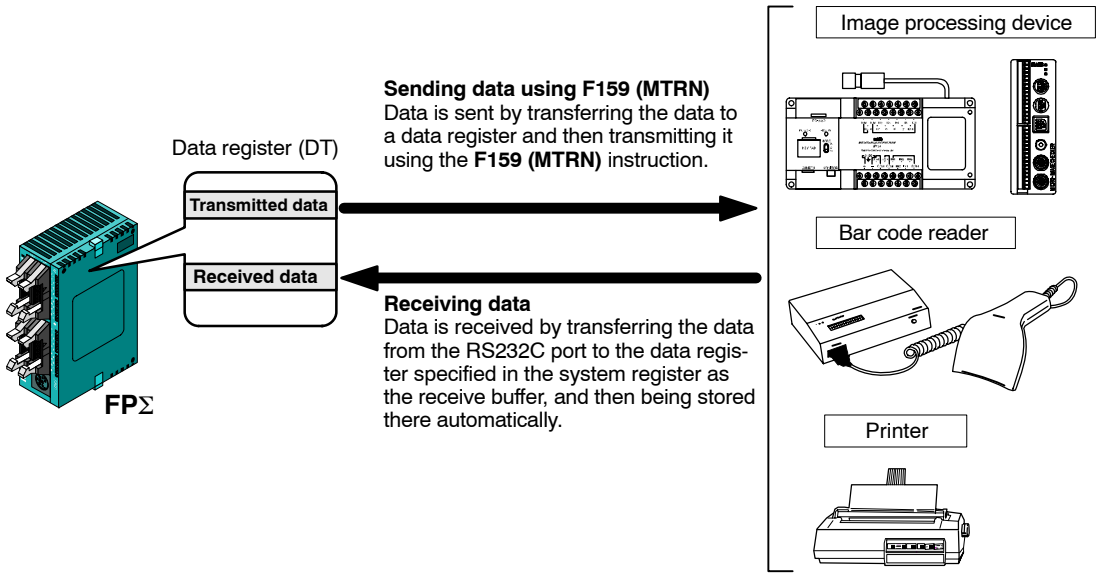


Chapter 10

General–Purpose Serial Communication

10.1 Overview

In general–purpose serial communication, data is sent and received over the COM ports to and from an external device such as an image processing device or a bar code reader. Data is read from and written to an external device connected to the COM port by means of an FPΣ program and the FPΣ data registers.

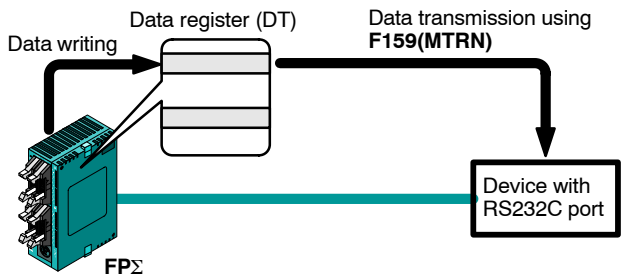

Image processing device
Sending data using F159 (MTRN)
Data is sent by transferring the data to a data register and then transmitting it using the F159 (MTRN) instruction.
Data register (DT)
Transmitted data
Received data
Bar code reader
Receiving data
Data is received by transferring the data from the RS232C port to the data register specified in the system register as the receive buffer, and then being stored there automatically.
Printer
FPΣ

10.1.1 Outline of Operation

To send data to and receive it from an external device using the general–purpose serial communication function, the data transmission and data reception functions described below are used. The **F159 (MTRN)** instruction and the "reception done" flag are used in these operations, to transfer data between the FPΣ and an external device.

Sending data

Data to be transmitted from the PLC is stored in the data register used as the send buffer (DT). When **F159 (MTRN)** is executed, the data is output from the COM port.

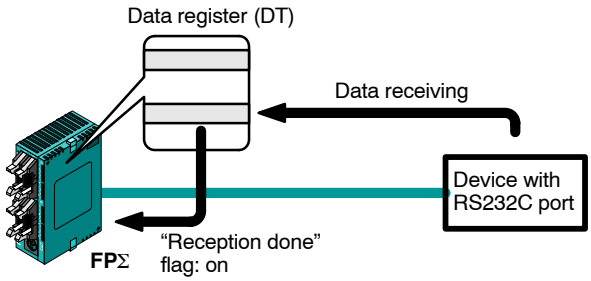


The terminator specified in the system register is automatically added to the data that has been sent.

The maximum volume of data that can be sent is 2,048 bytes.

Receiving data

Data received from the COM port is stored in the receive buffer specified in the system register, and the "reception done" flag goes on. Data can be received whenever the "reception done" flag is off.



When data is being received, the "reception done" flag is controlled by the **F159 (MTRN)** instruction.

No terminator is included in the stored data.

The maximum volume of data that can be received is 4,096 bytes.

10.1.2 Programming Example

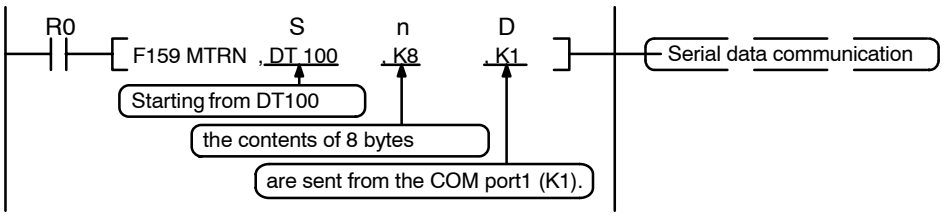
The **F159 (MTRN)** instruction is used to send and receive data via the specified COM port. **F159 (MTRN)** is only used with the FPΣ. It is an updated version of **F144 (TRNS)** and allows multiple communication ports to be accommodated.

Note

When programming with FPWIN Pro, the F144 (TRNS) s, n instruction is internally compiled on the FPΣ to F159 (MTRN) s_Start, n_Number, d_Port*=1. On all other PLCs, F159 (MTRN) is internally compiled to F144 (TRNS) s, n. In FPWIN GR, F144 (TRNS) is not available with the FPΣ.

Programming example:

FPWIN GR:



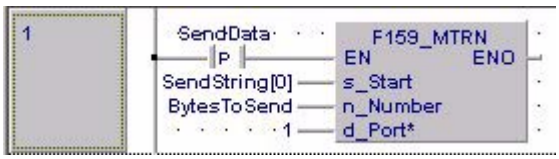
Devices that can be specified for S	Only data registers (DT) can be specified as the send buffer.
Devices that can be specified by n	WX, WY, WR, WL, SV, EV, DT, LD, I (I0 to ID), K, H
Devices that can be specified by D	Only the K constants (only K1 and K2)

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	SendData	BOOL	FALSE	Activates function
1	VAR	BytesToSend	WORD	8	
2	VAR	SendString	ARRAY [0..3] OF WORD	[4(0)]	

LD Body



Note

For an example on how to create the send buffer, please see "Example for F159" in the online help of FPWIN Pro.

Transmission of data

The amount of data specified by n is sent to the external device from among the data stored in the data table, starting with the area specified by S, through the COM port specified by D (FPWIN Pro: d_Port*). Data can be sent with the header and terminator automatically attached. A maximum of 2,048 bytes can be sent. When the above program is run, the eight bytes of data contained in DT101 to DT104 and stored in the send buffer starting from DT100 are sent from COM port 1.

Reception of data

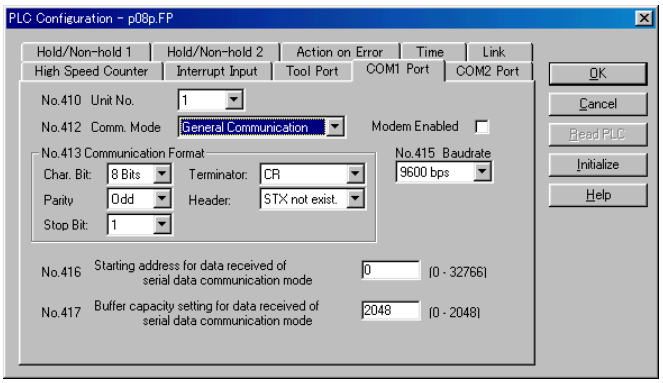
Reception of data is controlled by turning the "reception done" flags R9038/R9048 on and off. The received data is stored in the receive buffer specified in the system register. Data can be received when **F159 (MTRN)** turns the "reception done" flag off.

10.1.3 Setting Communication Parameters

By default, the COM port is set to "Computer link". System register settings should be entered for operation mode, communication format, baud rate, and receive buffer. The settings are made using the FPWIN Pro or FPWIN GR programming tool.

Procedure for FPWIN GR:

1. Option –> PLC Configuration



2. Click “COM. 1 & 2 Port” tab

There are separate settings for COM port 1 and 2.

No. 412 Communication mode

Select the COM port operation mode: click on ▼, and select “General Communication”.

No. 413 (for COM.1 port), No. 414 (for COM.2 port)

Default settings:

Character bit	8 Bits
Parity	Odd
Stop bit	1 Bit
Terminator	CR
Header	STX not exist

Enter the appropriate settings to match the communication format of the external device connected to the COM port.

No. 415 Baud rate setting

The default setting for the baud rates for the ports is 9600 bps.

Set the baud rate to match the external device connected to the COM port: click on ▼, and select one of the values from 2400 to 115200 bps.

No. 416 (for COM.1 port), No. 418 (for COM.2 port)
Starting address for data received
No. 417 (for COM.1 port), No. 419 (for COM.2 port)
Buffer capacity setting for data received

To use general–purpose serial communication, the receive buffer must be specified. By default, the entire data register area is defined as the receive buffer. To change this area, specify the starting address using system register no. 416 (no. 418 for COM port 2) and the volume (number of words) using no. 417 (no. 419 for COM port 2). The receive buffer layout is shown below (see page 10-7).

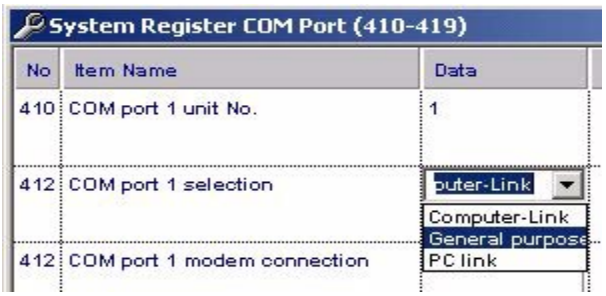
Procedure for FPWIN Pro:

1. **Double–click “PLC” in the project navigator**
2. **Double–click “System Register”**
3. **Double–click “COM Port”**

   There are separate settings for COM ports 1 and 2.

   No. 412: COM port 1 selection

   Select the COM port operation mode: click on ▼, and select “General–purpose”.



   No. 413 (for COM port 1), no. 414 (for COM port 2): communication format setting

   Default settings:

Data length	8 Bits
Parity	Odd
Stop bit	1 Bit
Terminator	CR
Header	STX not exist

   Enter the appropriate settings to match the communication format of the external device connected to the COM port.

   No. 415: baud rate

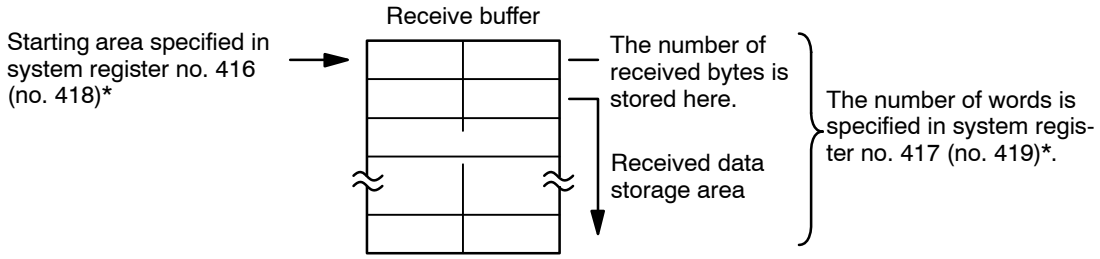
   The default baud rate for the various ports is 9600 bps.

   Change the value to match the external device connected to the COM port: click on ▼, and select one of the values from 2400 to 115200 bps.

   No. 416 (for COM port 1), no. 418 (for COM port 2): starting address receive buffer
   No. 417 (for COM port 1), no. 419 (for COM port 2): receive buffer capacity

   To use general–purpose serial communication, the receive buffer must be specified. By default, the entire data register area is defined as the receive buffer. To change this area, specify the starting address using system register no. 416 (no. 418 for COM port 2) and the volume (number of words) using no. 417 (no. 419 for COM port 2). The receive buffer layout is shown below (see page 10-7).

Receive buffer layout


Receive buffer
Starting area specified in system register no. 416 (no. 418)*
The number of received bytes is stored here.
Received data storage area
The number of words is specified in system register no. 417 (no. 419)*.

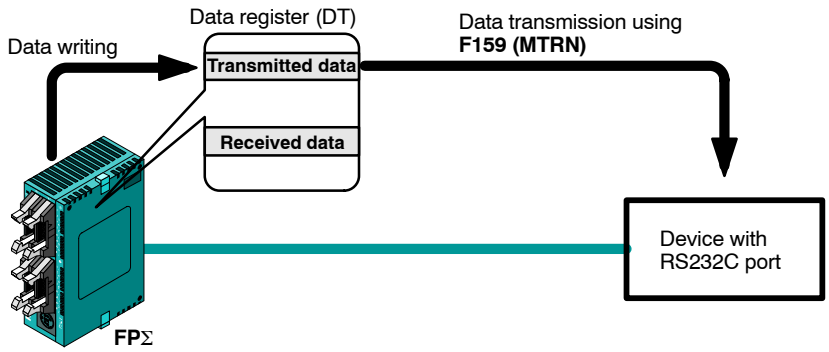
* The system register numbers in parentheses refer to COM port 2.

10.2 Communication with External Devices

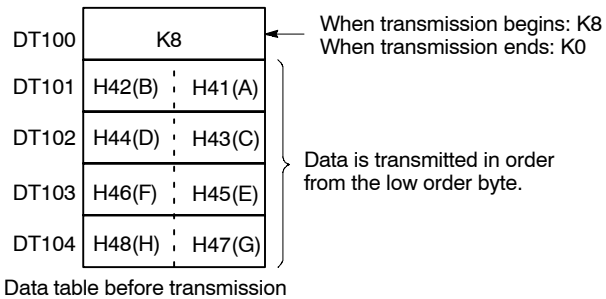
This section explains data transmission and data reception when communicating with external devices. Communication with external devices is handled through the data registers.

10.2.1 Sending Data to External Devices

Data to be output is stored in the data register used as the send buffer (DT), and when the **F159 (MTRN)** instruction is executed, the data is output from the COM port.

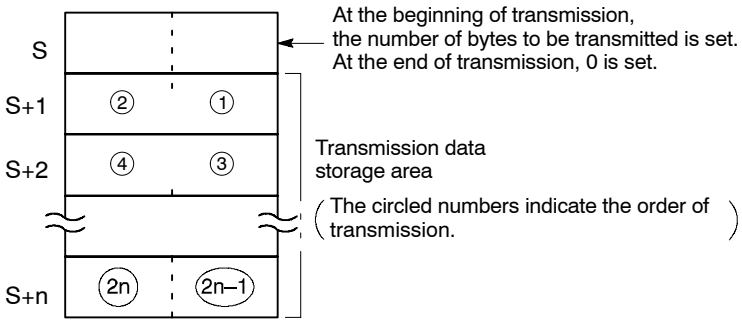


Data table for transmission (send buffer)



Explanation of data table

The data table for transmission starts at the data register specified in S.



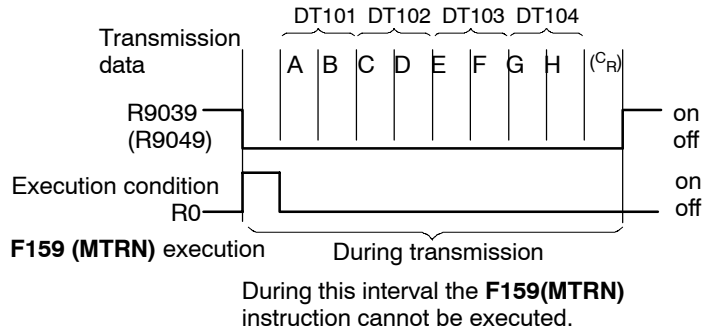
Use an **F0(MV)** or **F95(ASC)** instruction to write the data to be transmitted to the transmission data storage area specified in S.

In FPWIN Pro, it is more convenient to use the data type “String”. With this data type, it is easier to handle strings containing more than 12 characters. Therefore, **Adr_Of_VarOffs_I** is recommended instead of **F95 (ASC)**. **Adr_Of_VarOffs_I** delivers only the text characters without the header characters (2 words). For more information on the data type “String”, please refer to the online help.

Transmission process

When the execution condition of the **F159(MTRN)** instruction turns on and the “transmission done” flag R9039/R9049 is on, operation is as follows:

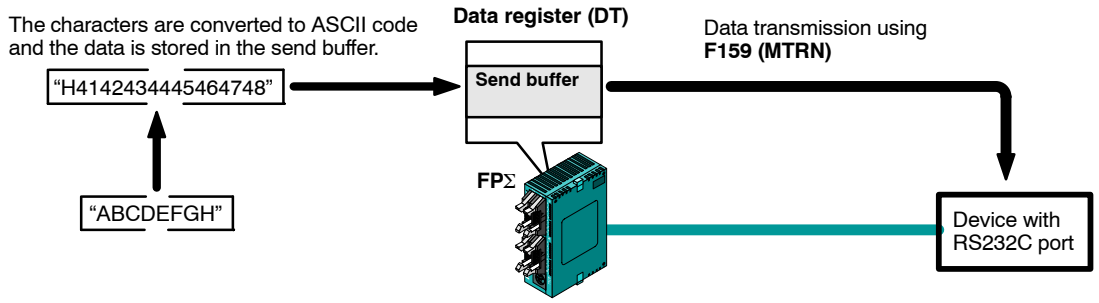
1. n is preset in S. The “reception done” flag R9038/R9048 is turned off, and the reception data number is cleared to 0.
2. The set data is transmitted in order from the lower–order byte in S+1 of the table.
   - During transmission, the “transmission done” flag R9039/R9049 turns off.
   - If system register 413 or 414 is set to header (start code) with STX, the header is automatically added to the beginning of the data.
   - The terminator (end code) specified in system register 413 or 414 is automatically added to the end of the data.



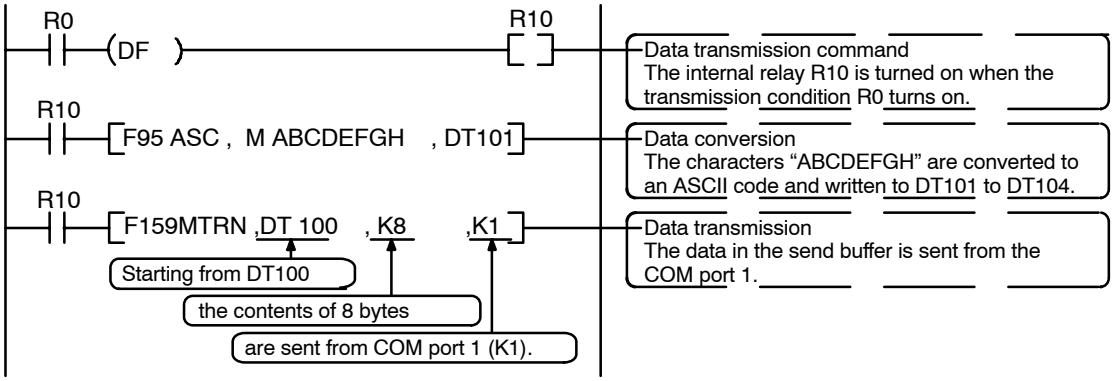
3. When all of the specified quantity of data has been transmitted, the S value is cleared to 0 and the “transmission done” flag R9039/R9049 turns on.

Programming example: **The following program transmits the characters "ABCDEFGH" to an external device using COM port 1.**

Explanatory diagram


The characters are converted to ASCII code and the data is stored in the send buffer.
"H4142434445464748"
"ABCDEFGH"
Data register (DT)
Send buffer
FPΣ
Data transmission using F159 (MTRN)
Device with RS232C port

FPWIN GR:


R0
DF
R10
Data transmission command
The internal relay R10 is turned on when the transmission condition R0 turns on.
R10
F95 ASC , M ABCDEFGH , DT101
Data conversion
The characters "ABCDEFGH" are converted to an ASCII code and written to DT101 to DT104.
R10
F159MTRN ,DT 100 , K8 ,K1
Starting from DT100
the contents of 8 bytes
are sent from COM port 1 (K1).
Data transmission
The data in the send buffer is sent from the COM port 1.

The program described above is executed in the following sequence.

(1) "ABCDEFGH" is converted to an ASCII code and stored in a data register.

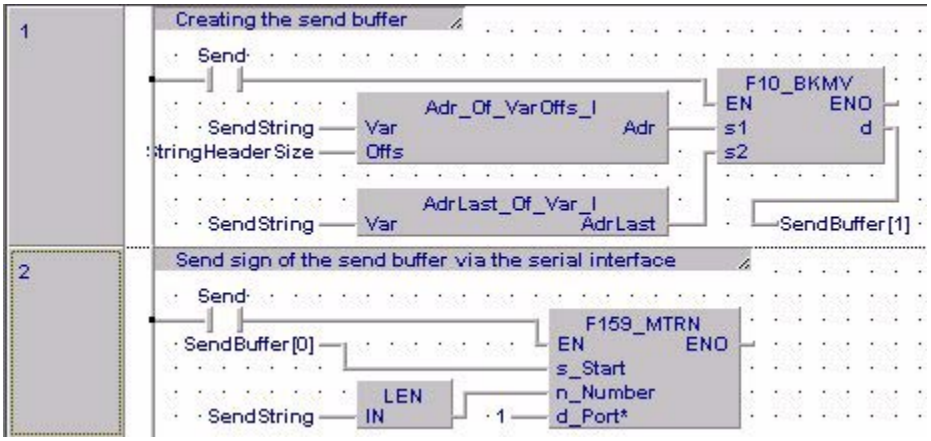
(2) The data is sent from COM port 1 using the **F159 (MTRN)** instruction.

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	Send	BOOL	FALSE	activates function
1	VAR	SendString	STRING[30]	'ABCDEFGH'	up to 30 chars
2	VAR	SendBuffer	ARRAY [0..15] OF WORD	[16(0)]	for 30 chars + 1 word
3	VAR_CONSTANT	StringHeaderSize	INT	2	1 word max. no. chars 1 word current no. chars

LD Body

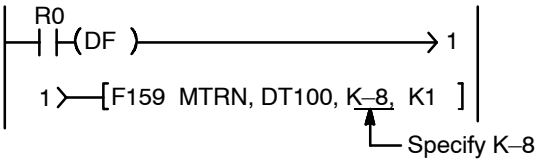


Notes

- **When you do not wish to add the terminator (end code) during transmissions, specify the number of bytes to be transmitted using a negative number. If you also do not wish to add a terminator to received data, set system register 413 or 414 to "No–STX" (FPWIN Pro) or "Terminator – None" (FPWIN GR).**

Programming example: The following program transmits 8 bytes of data without adding the terminator.

– FPWIN GR:

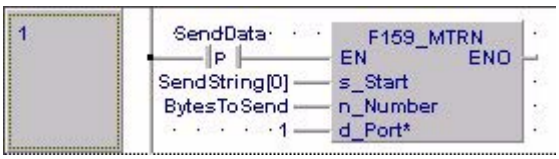


– FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	SendData	BOOL	FALSE	
1	VAR	BytesToSend	INT	-8	negative number = no terminator added
2	VAR	SendString	ARRAY [0..3] OF WORD	[4(0)]	

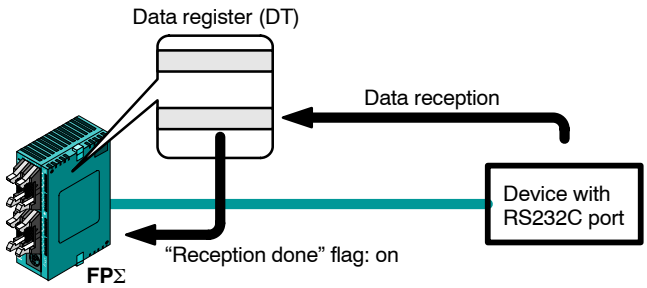
LD Body



- **Do not include the terminator (end code) in the transmission data. The terminator is added automatically.**
- **When "STX" (FPWIN Pro) or "STX exist" (FPWIN GR) is specified for the header (start code) in system register 413 or 414, do not add the header to the transmission data. The header is added automatically.**
- **When using the 1–channel RS232C type communication cassette, transmission does not take place until CS (Clear to Send) turns on. If you are not going to connect to the other device, connect to RS (Request to Send).**
- **The maximum number of transmission bytes n is 2048.**

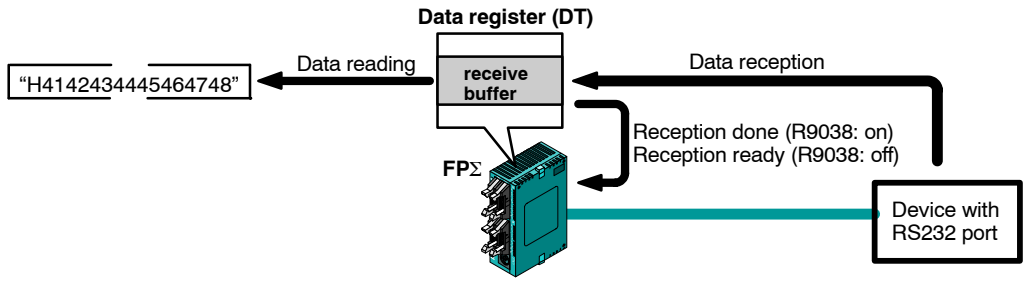
10.2.2 Receiving Data from External Devices

Data input from the COM port is stored in the receive buffer specified by the system register, and the “reception done” flag goes on. If the “reception done” flag is off, data can be received at any time.

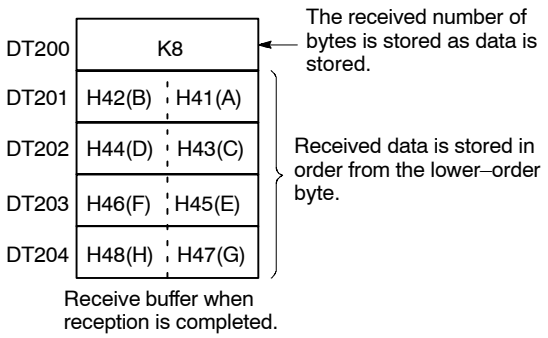


Programming example: **4 words (8 characters) received in the receive buffer at DT200 through COM port 1 are copied to DT0.**

Explanatory diagram



Data table for reception (receive buffer)

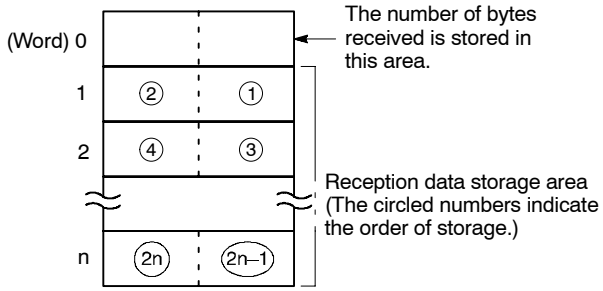


DT200 to DT204 are used as the receive buffer. System register settings are as follows:

– System register 416: K200
– System register 417: K5

Explanation of data table

Data sent from an external device connected to the RS232C port is stored in the data registers that have been set as the receive buffer. Specify the data registers in system registers 416 to 419.



The number of bytes of data received is stored in the starting address of the receive buffer. The initial value is 0.

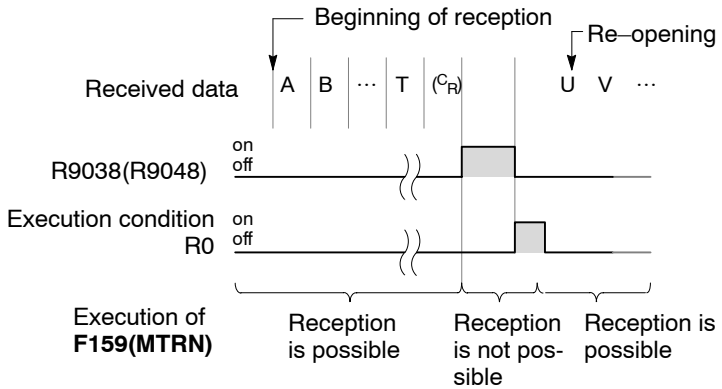
Received data is stored in the received data storage area in order from the lower–order byte.

Reception process

When the “reception done” flag R9038(R9048) is off, operation takes place as follows when data is sent from an external device. (The R9038(R9048) flag is off during the first scan after RUN).

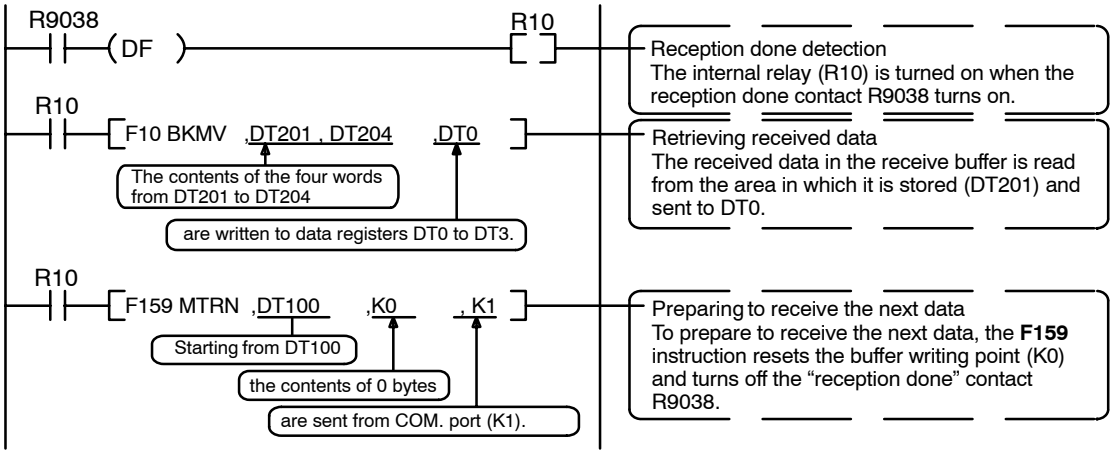
1. Incoming data is stored in order from the lower–order byte of the 2nd–word area of the receive buffer.

   Header and terminator (start and end codes) are not stored.



2. When the terminator (end code) is received, the “reception done” flag R9038 (R9048) turns on. Reception of any further data is prohibited.
3. When an **F159(MTRN)** instruction is executed, the “reception done” flag R9038 (R9048) turns off, the number of received bytes is cleared, and subsequent data is stored in order from the lower–order byte.

FPWIN GR:


R9038
DF
R10
Reception done detection
The internal relay (R10) is turned on when the reception done contact R9038 turns on.
R10
F10 BKMV ,DT201 , DT204 ,DT0
The contents of the four words from DT201 to DT204
are written to data registers DT0 to DT3.
Retrieving received data
The received data in the receive buffer is read from the area in which it is stored (DT201) and sent to DT0.
R10
F159 MTRN ,DT100 ,K0 , K1
Starting from DT100
the contents of 0 bytes
are sent from COM. port (K1).
Preparing to receive the next data
To prepare to receive the next data, the F159 instruction resets the buffer writing point (K0) and turns off the "reception done" contact R9038.

The program described above is executed in the following sequence.

1. Data is received from the RS232C device to the receive buffer.
2. The "reception done" contact R9038 (R9048) is turned on.
3. The received data is sent from the receive buffer to the area starting with data register DT0.
4. The **F159 (MTRN)** instruction is executed with no data (FPWIN Pro: n_Number = 0; FPWIN GR: K0) to reset the buffer writing point and to turn off the "reception done" contact R9038 (R9048).
   The system is now ready to receive the next data.

FPWIN Pro:

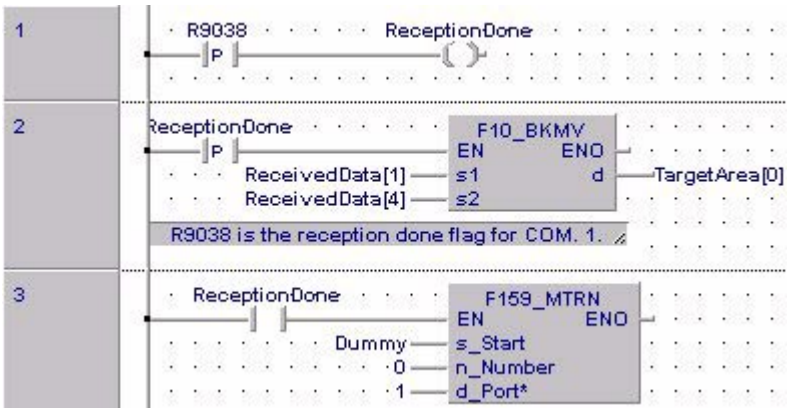
Global Variable List

	Class	Identifier	Matsushit	IEC_Addr	Type	Initial
0	VAR_GLOBAL	ReceivedData	DT200	%MW5.200	ARRAY [0..4] OF WORD	[5(0)]
1	VAR_GLOBAL	TargetArea	DT0	%MW5.0	ARRAY [0..3] OF WORD	[4(0)]

POU Header

	Class	Identifier	Type	Initial
0	VAR_EXTERNAL	ReceivedData	ARRAY [0..4] OF WORD	[5(0)]
1	VAR_EXTERNAL	TargetArea	ARRAY [0..3] OF WORD	[4(0)]
2	VAR	Dummy	WORD	0
3	VAR	ReceptionDone	BOOL	FALSE

LD Body



R9038 may change while a scan is being carried out. To ensure proper execution of the program, the status of the special internal relay should be copied to a variable at the beginning of the program.

10.2.2.1 Performing Repeated Reception of Data

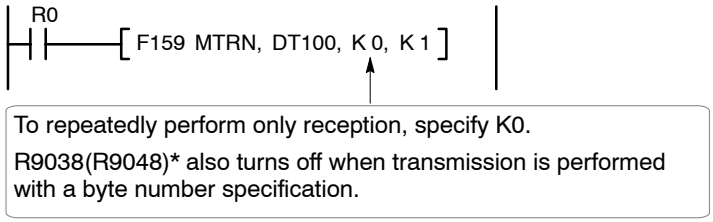
For repeated reception of data, perform the following steps:

1. Receive data
2. Reception done (R9038/R9048: on, reception prohibited)
3. Process received data
4. Execute **F159(MTRN)** (R9038/R9048: off, reception possible)
5. Receive subsequent data

The “reception done” flag R9038 (R9048)* turns on when data reception from the external device is completed. Reception of any further data is prohibited.

To receive subsequent data, you must execute the **F159(MTRN)** instruction to turn off the “reception done” flag R9038(R9048)*.

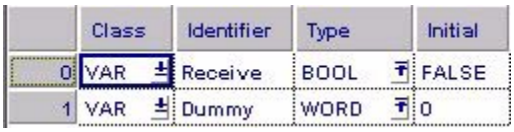
FPWIN GR:


R0
F159 MTRN, DT100, K 0, K 1
To repeatedly perform only reception, specify K0.
R9038(R9048)* also turns off when transmission is performed with a byte number specification.

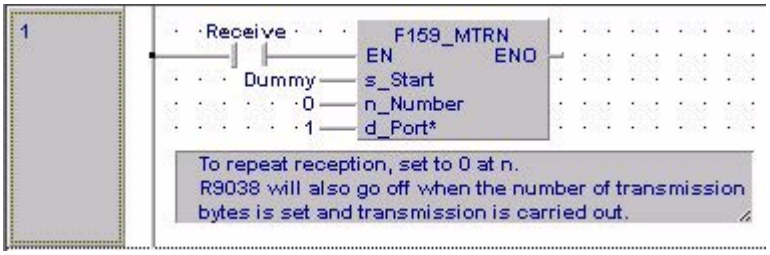
* The contact numbers in parentheses refer to COM port 2.

FPWIN Pro:

POU Header



LD Body

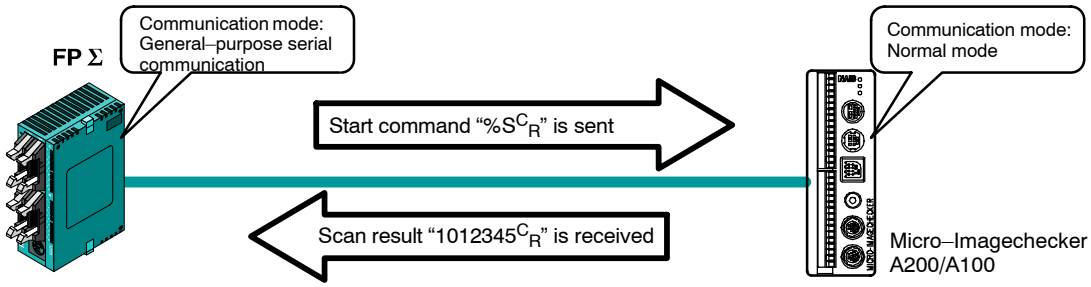


10.3 Connection Examples

The following examples demonstrate how the PLC can be connected to external devices via 1:1 general–purpose serial communication.

10.3.1 1:1 Communication With Micro–Imagechecker

The FPΣ and Micro–Imagechecker A200/A100 are connected using an RS232C cable. The results of the scan are stored in the data registers of the FPΣ.



After the scan start code "%SCR" has been sent from the FPΣ side, the scan result is returned from the Micro–Imagechecker as the response.

Communication cassette

The following types of communication cassettes can be used with 1:1 general–purpose serial communication.

Name	Description	Part No.
FPΣ communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

System register settings

In the default settings, the COM port is set to computer link mode. For 1:1 general–purpose serial communication, the system registers should be set as shown below.

• Settings for COM port 1

No.	Name	Set value
No. 412	Communication mode	General–purpose serial communication
No. 413	Communication format	Data length: . . . . . 8 bits Parity: . . . . . Odd Stop bit: . . . . . 1 bit Terminator:. . . . . CR Header: . . . . . No STX
No. 415	Baud rate	9600 bps
No. 416	Starting address for receive buffer	200
No. 417	Receive buffer capacity	50 words (100 bytes)

• Settings for COM port 2

No.	Name	Set value
No. 412	Communication mode	General–purpose serial communication
No. 414	Communication format	Data length: . . . . . 8 bits Parity: . . . . . Odd Stop bit: . . . . . 1 bit Terminator:. . . . . CR Header: . . . . . No STX
No. 415	Baud rate	9600 bps
No. 418	Starting address for receive buffer	200
No. 419	Receive buffer capacity	50 words (100 bytes)

Communication format settings for Micro–Imagechecker

To set the communication mode and transmission format settings for the Micro–Imagechecker, select “5: Communication” under “5: ENVIRONMENT” on the main menu, and set the following items.

No.	Name	Set value
No. 51	Communication mode	Normal Mode
No. 52	RS232C	Baud rate (bps) . . . . . 9600 bit/s Length . . . . . 8 Stop bit . . . . . 1 Parity . . . . . Odd Flow Control . . . . . None

Serial communication setting for Micro–Imagechecker

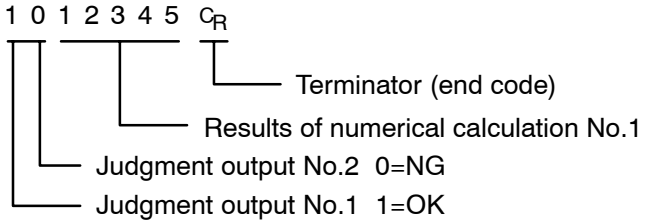
To enter settings relating to serial communication for the Micro–Imagechecker, select “53: Serial Output” under “5: Communication” on “5: ENVIRONMENT” on the main menu, and set the following items.

No.	Name	Set value
No. 53	Serial Output	Output . . . . . 5 Column Invalid Digit . . . . . Repl. 0 Read End . . . . . None Process End . . . . . None Numerical Calculation . Output Judgment . . . . . Output

Notes

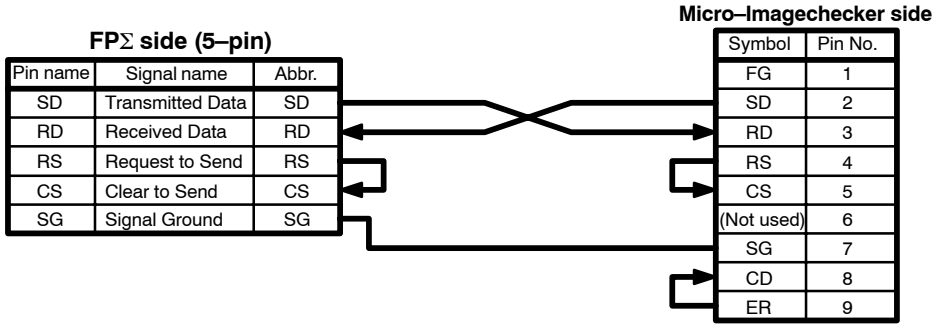
- **If “Del” is specified for the invalid processing parameter, zero suppression processing will be carried out on the output data, and the output format will be changed. Always make sure “Repl. 0” is specified.**
- **When outputting data to an external device, numerical calculation is required, so “Out” should be specified for the “Numerical calculation” parameter.**

With the above settings, the following data will be output from the Micro–Imagechecker:



Connection to Micro–Imagechecker A200/A100

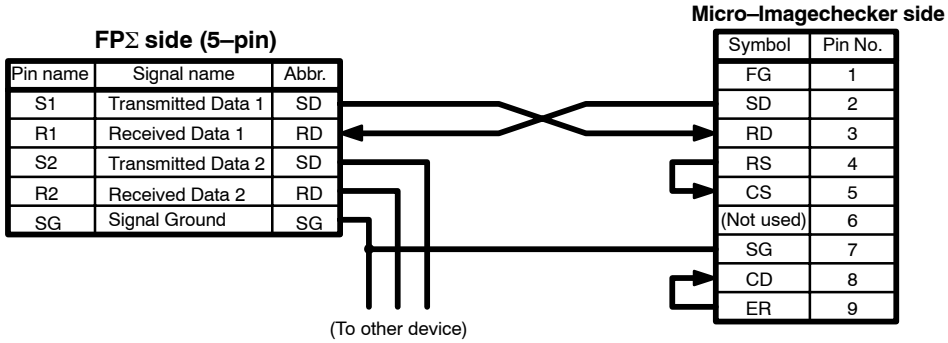
• Using 1–channel RS232C type communication cassette



Pin name	Signal name	Abbr.
SD	Transmitted Data	SD
RD	Received Data	RD
RS	Request to Send	RS
CS	Clear to Send	CS
SG	Signal Ground	SG

Symbol	Pin No.
FG	1
SD	2
RD	3
RS	4
CS	5
(Not used)	6
SG	7
CD	8
ER	9

• Using 2–channel RS232C type communication cassette

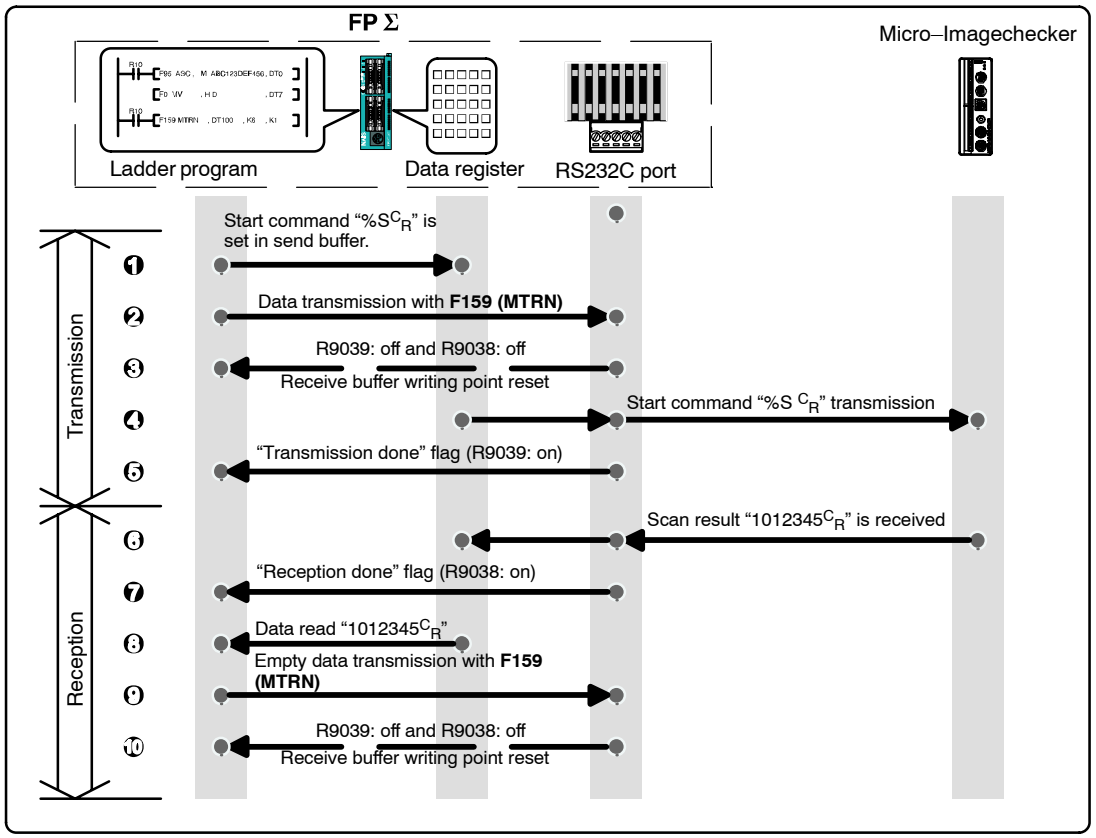


Pin name	Signal name	Abbr.
S1	Transmitted Data 1	SD
R1	Received Data 1	RD
S2	Transmitted Data 2	SD
R2	Received Data 2	RD
SG	Signal Ground	SG

Symbol	Pin No.
FG	1
SD	2
RD	3
RS	4
CS	5
(Not used)	6
SG	7
CD	8
ER	9

Procedure of communication

In the following example, the Micro–Imagechecker is connected to COM port 1.



Buffer statuses

The following shows the statuses of the send and receive buffers when the sample program is run.

Send buffer

DT100	K2	← Number of bytes to be transmitted
DT101	H53 (S) | H25 (%)	

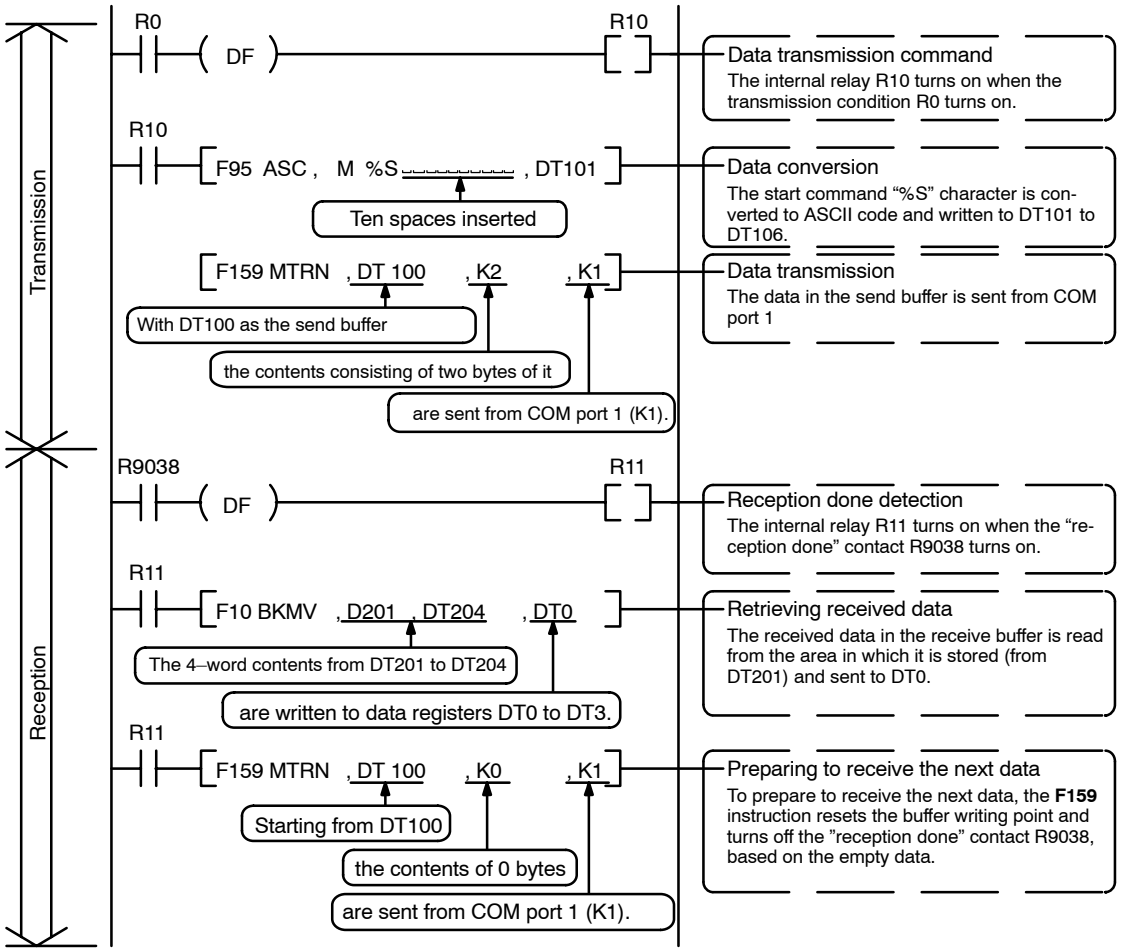
(Statuses before transmission)

Receive buffer

DT200	K7	← Number of bytes received
DT201	H30 (0) | H31 (1)	Received data is stored in order from the lower–order byte.
DT202	H32 (2) | H31 (1)	
DT203	H34 (4) | H33 (3)	
DT204	| H35 (5)	

(Statuses when reception is completed)

FPWIN GR:


Transmission
Reception
R0
DF
R10
Data transmission command
The internal relay R10 turns on when the transmission condition R0 turns on.
R10
F95 ASC , M %S , DT101
Ten spaces inserted
Data conversion
The start command "%S" character is converted to ASCII code and written to DT101 to DT106.
F159 MTRN , DT 100 , K2 , K1
With DT100 as the send buffer
the contents consisting of two bytes of it
are sent from COM port 1 (K1).
Data transmission
The data in the send buffer is sent from COM port 1
R9038
DF
R11
Reception done detection
The internal relay R11 turns on when the "reception done" contact R9038 turns on.
R11
F10 BKMV , D201 , DT204 , DT0
The 4–word contents from DT201 to DT204
are written to data registers DT0 to DT3.
Retrieving received data
The received data in the receive buffer is read from the area in which it is stored (from DT201) and sent to DT0.
R11
F159 MTRN , DT 100 , K0 , K1
Starting from DT100
the contents of 0 bytes
are sent from COM port 1 (K1).
Preparing to receive the next data
To prepare to receive the next data, the F159 instruction resets the buffer writing point and turns off the "reception done" contact R9038, based on the empty data.

FPWIN Pro:

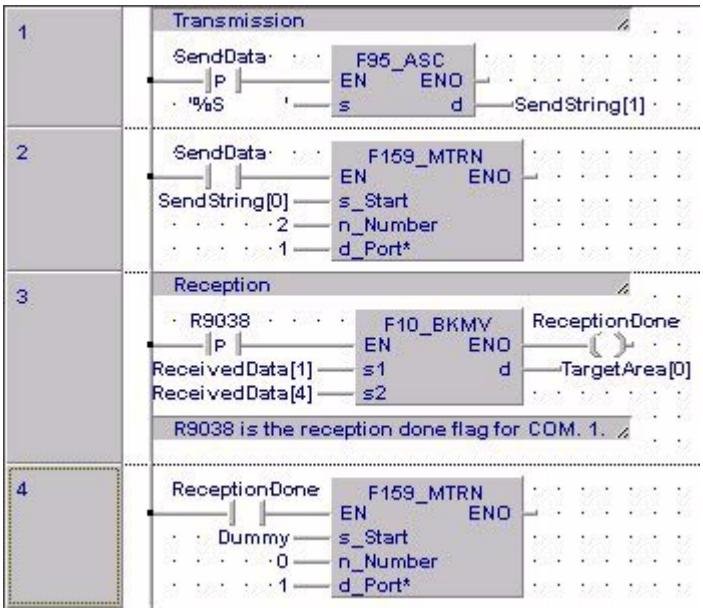
GVL

	Class	Identifier	Matsushit	IEC_Addr	Type	Initial
0	VAR_GLOBAL	ReceivedData	DT200	%MW5.200	ARRAY [0..4] OF WORD	[5(0)]

POU Header

	Class	Identifier	Type	Initial
0	VAR	SendData	BOOL	FALSE
1	VAR	SendString	ARRAY [0..6] OF WORD	[7(0)]
2	VAR_EXTERNAL	ReceivedData	ARRAY [0..4] OF WORD	[5(0)]
3	VAR	TargetArea	ARRAY [0..3] OF WORD	[4(0)]
4	VAR	Dummy	WORD	0
5	VAR	ReceptionDone	BOOL	FALSE

LD Body

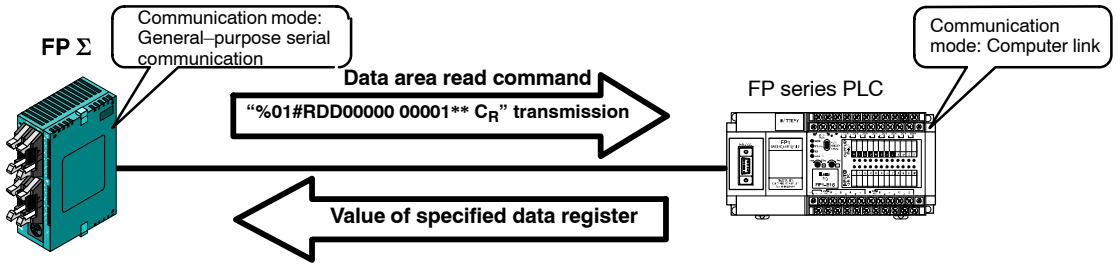


In FPWIN Pro, it is more convenient to use the data type “String”. With this data type, it is easier to handle strings containing more than 12 characters. Therefore, **Adr_Of_VarOffs_I** is recommended instead of **F95 (ASC)**. **Adr_Of_VarOffs_I** delivers only the text characters without the header characters (2 words). For more information on the data type “String”, please refer to the online help.

R9038 may change while a scan is being carried out. To ensure proper execution of the program, the status of the special internal relay should be copied to a temporary variable.

10.3.2 1:1 Communication With FP Series PLC

Connect the FPΣ and another FP series PLC using the RS232C interface and the MEWTOCOL–COM communication protocol.



When the data area read command "%01#RDD00000 00001** $^{C}_{R}$" is sent from the FPΣ side, the values of the data register of the PLC connected to the system are sent as a response. For example, if the value K100 is stored in DT0 and the value K200 is stored in DT1 of the PLC, "%01$RD6400C8006F$^{C}_{R}$" is sent as a response to the command. If there is an error, "%01! OO ** $^{C}_{R}$" is returned (OO is the error code).

In addition to data area read and write commands, MEWTOCOL–COM also provides contact area read and write as well as many other commands.

Communication cassette

The following types of communication cassettes can be used for 1:1 general–purpose serial communication.

Name	Description	Part No.
FPΣ communication cassette 1–channel RS232C type	This communication cassette is a 1–channel unit with a five–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. RS/CS control is possible.	FPG–COM1
FPΣ communication cassette 2–channel RS232C type	This communication cassette is a 2–channel unit with a three–wire RS232C port. It supports 1:1 computer links and general–purpose serial communication. Communication with two external devices is possible.	FPG–COM2

System register settings

In the default settings, the COM port is set to computer link mode. For 1:1 general–purpose serial communication, the system registers should be set as shown below.

- Settings for COM port 1

No.	Name	Set value
No. 412	Communication mode	General–purpose serial communication
No. 413	Communication format	Data length: . . . . . 8 bits Parity: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . No STX
No. 415	Baud rate setting	19200 bps
No. 416	Starting address for receive buffer	200
No. 417	Receive buffer capacity	50 words (100 bytes)

- Settings for COM port 2

No.	Name	Set value
No. 412	Communication mode	General–purpose serial communication
No. 414	Communication format	Data length: . . . . . 8 bits Parity: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . No STX
No. 415	Baud rate setting	19200 bps
No. 418	Starting address for receive buffer	200
No. 419	Receive buffer capacity	50 words (100 bytes)

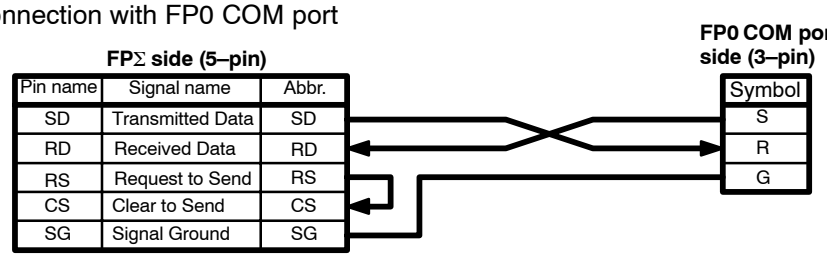
Communication format settings for FP series PLC (FP0, FP1)

No.	Name	Set value
No. 412	Communication mode for COM port	Computer link
No. 413	Communication format for COM port	Data length: . . . . . 8 bits Parity: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . No STX
No. 414	Baud rate for COM port	19200 bps

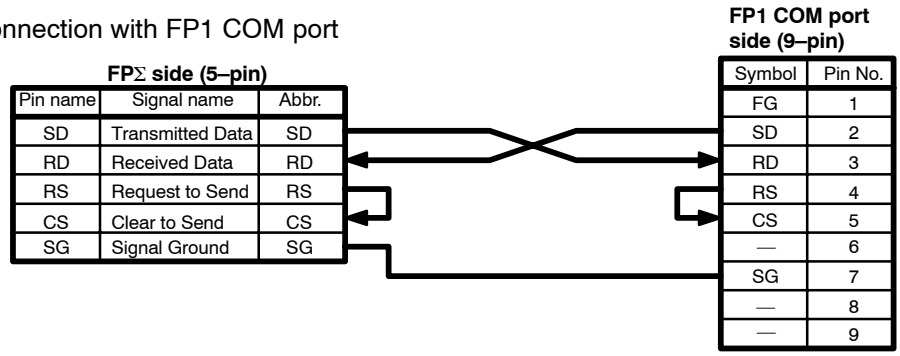
Connection to FP series PLCs (FP0, FP1)

- Using 1–channel RS232C type communication cassette

Connection with FP0 COM port

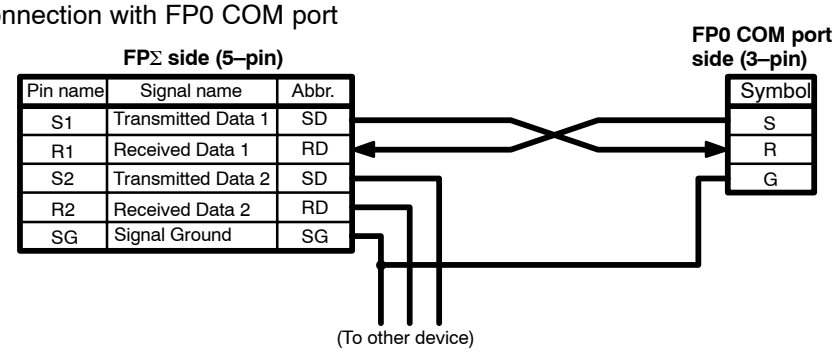


Connection with FP1 COM port



- Using 2–channel RS232C type communication cassette

Connection with FP0 COM port



Connection with FP1 COM port

FPΣ side (5–pin)

Pin name	Signal name	Abbr.
S1	Transmitted Data 1	SD
R1	Received Data 1	RD
S2	Transmitted Data 2	SD
R2	Received Data 2	RD
SG	Signal Ground	SG

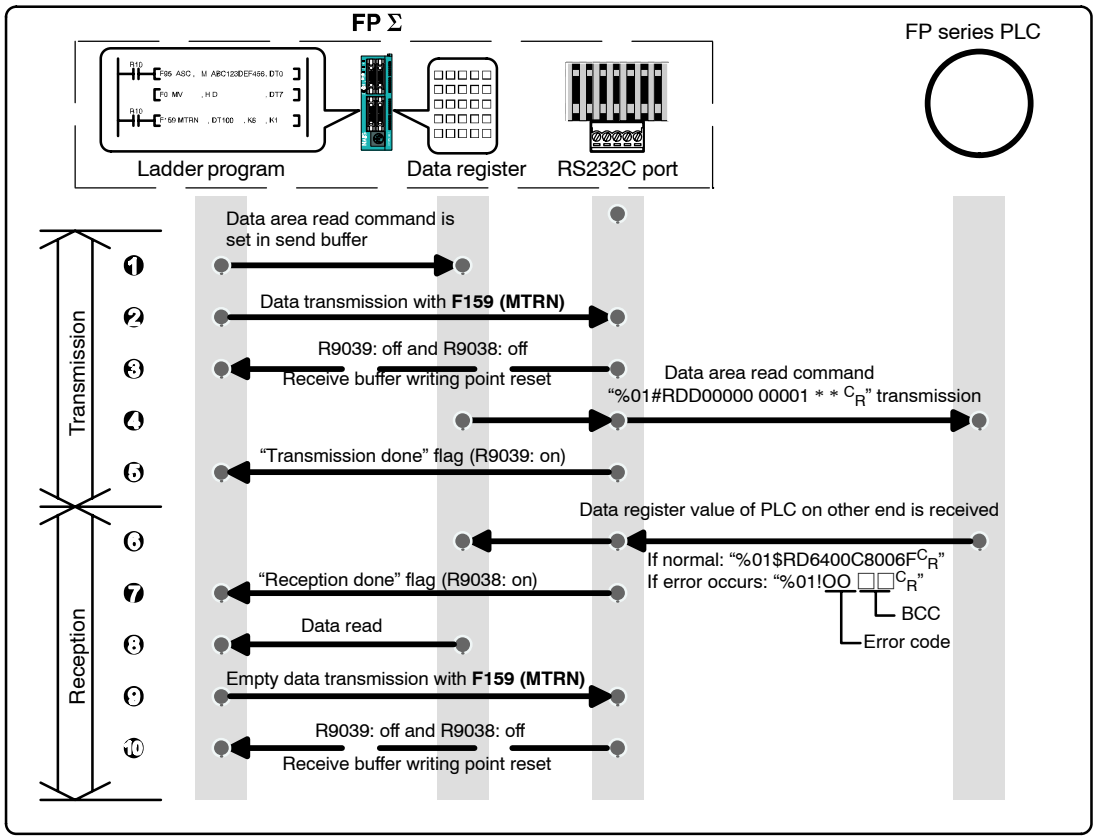
FP1 COM port side (9–pin)

Symbol	Pin No.
FG	1
SD	2
RD	3
RS	4
CS	5
—	6
SG	7
—	8
—	9

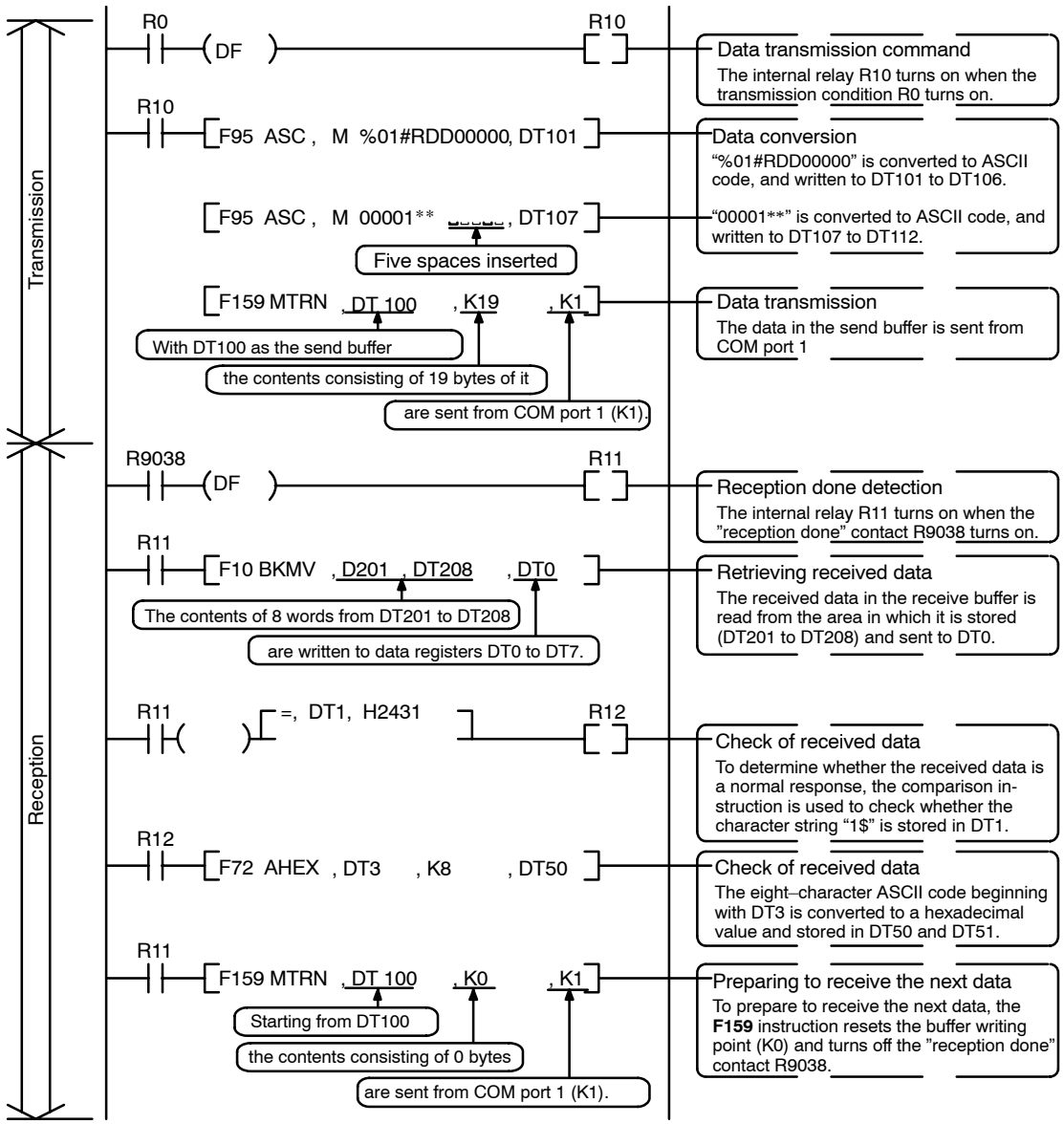
(To other device)

Procedure of communication

In this example, an FP series PLC is connected to COM port 1. K100 and K200 are respectively being stored in DT0 and DT1 of the PLC on the other end.


FP Σ
FP series PLC
Ladder program
Data register
RS232C port
Transmission
Reception
Data area read command is set in send buffer
Data transmission with F159 (MTRN)
R9039: off and R9038: off
Receive buffer writing point reset
Data area read command
"%01#RDD00000 00001 ** CR" transmission
"Transmission done" flag (R9039: on)
Data register value of PLC on other end is received
If normal: "%01$RD6400C8006FCR"
If error occurs: "%01!OO □□CR"
BCC
Error code
"Reception done" flag (R9038: on)
Data read
Empty data transmission with F159 (MTRN)
R9039: off and R9038: off
Receive buffer writing point reset

FPWIN GR:

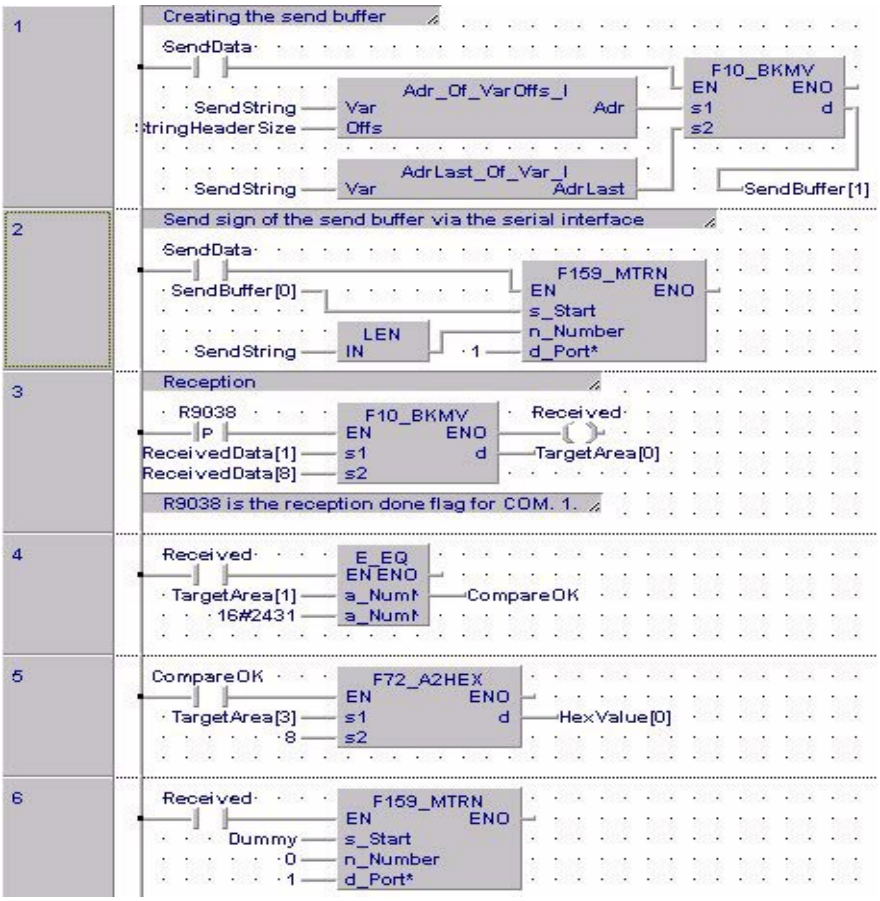

Transmission
Reception
R0
DF
R10
Data transmission command
The internal relay R10 turns on when the transmission condition R0 turns on.
R10
F95 ASC , M %01#RDD00000, DT101
Data conversion
"%01#RDD00000" is converted to ASCII code, and written to DT101 to DT106.
F95 ASC , M 00001** , DT107
"00001**" is converted to ASCII code, and written to DT107 to DT112.
Five spaces inserted
F159 MTRN , DT 100 , K19 , K1
Data transmission
The data in the send buffer is sent from COM port 1
With DT100 as the send buffer
the contents consisting of 19 bytes of it
are sent from COM port 1 (K1).
R9038
DF
R11
Reception done detection
The internal relay R11 turns on when the "reception done" contact R9038 turns on.
R11
F10 BKMV , D201 , DT208 , DT0
Retrieving received data
The received data in the receive buffer is read from the area in which it is stored (DT201 to DT208) and sent to DT0.
The contents of 8 words from DT201 to DT208
are written to data registers DT0 to DT7.
R11
=, DT1, H2431
R12
Check of received data
To determine whether the received data is a normal response, the comparison instruction is used to check whether the character string "1$" is stored in DT1.
R12
F72 AHEX , DT3 , K8 , DT50
Check of received data
The eight–character ASCII code beginning with DT3 is converted to a hexadecimal value and stored in DT50 and DT51.
R11
F159 MTRN , DT 100 , K0 , K1
Preparing to receive the next data
To prepare to receive the next data, the F159 instruction resets the buffer writing point (K0) and turns off the "reception done" contact R9038.
Starting from DT100
the contents consisting of 0 bytes
are sent from COM port 1 (K1).

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	SendData	BOOL	FALSE	
1	VAR	SendString	STRING[30]	'ABCDEFGH'	up to 30 chars
2	VAR	SendBuffer	ARRAY [0..15] OF WORD	[16(0)]	for 30 chars + 1 word
3	VAR	ReceivedData	ARRAY [0..8] OF WORD	[9(0)]	
4	VAR	TargetArea	ARRAY [0..8] OF WORD	[9(0)]	
5	VAR	Dummy	WORD	0	
6	VAR	HexValue	ARRAY [0..1] OF WORD	[2(0)]	
7	VAR	CompareOK	BOOL	FALSE	
8	VAR	CharString	STRING[32]	'ABC'	
9	VAR	Received	BOOL	FALSE	
10	VAR_CONSTANT	StringHeaderSize	INT	2	1 word max. no. chars 1 word current no. chars

LD Body



In FPWIN Pro, it is more convenient to use the data type “String”. With this data type, it is easier to handle strings containing more than 12 characters. Therefore, **Adr_Of_VarOffs_I** is recommended instead of **F95 (ASC)**. **Adr_Of_VarOffs_I** delivers

only the text characters without the header characters (2 words). For more information on the data type “String”, please refer to the online help.

Buffer statuses

The tables below show the statuses of the send and receive buffers when the sample program is run.

Send buffer

DT100	K19	
DT101	H30 (0)	H25 (%)
DT102	H23 (#)	H31 (1)
DT103	H44 (D)	H52 (R)
DT104	H30 (0)	H44 (D)
DT105	H30 (0)	H30 (0)
DT106	H30 (0)	H30 (0)
DT107	H30 (0)	H30 (0)
DT108	H30 (0)	H30 (0)
DT109	H2A (*)	H31 (1)
DT110		H2A (*)

← Number of bytes to be transmitted

(Statuses before transmission)

Receive buffer

DT200	K16	
DT201	H30 (0)	H31 (%)
DT202	H32 ($)	H31 (1)
DT203	H34 (D)	H33 (R)
DT204	H34 (4)	H36 (6)
DT205	H30 (0)	H30 (0)
DT206	H38 (8)	H43 (C)
DT207	H30 (0)	H30 (0)
DT208	H46 (F)	H36 (6)

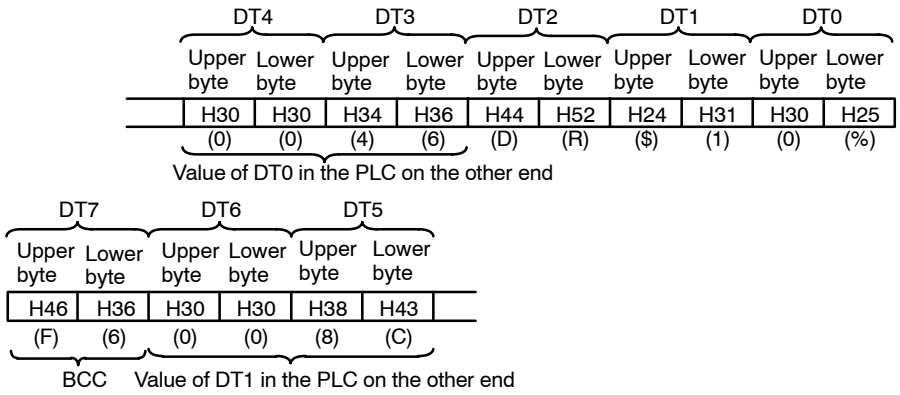
← Number of bytes received

Received data is stored in order from the lower–order byte.

(Statuses when reception is completed)

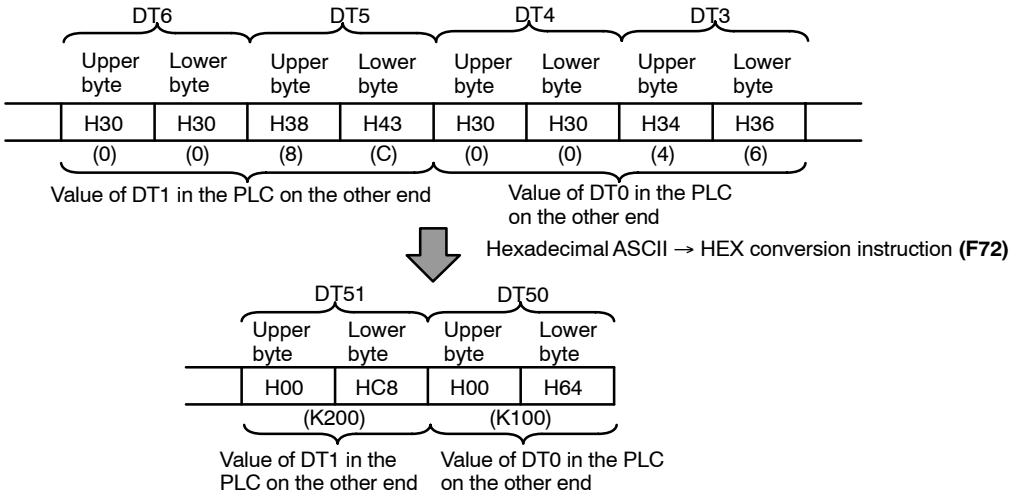
Contents of the response:

If K100 is stored in DT0 and K200 is stored in DT1 of the FP series PLC on the other end, “%01$RD6400C8006F$^{C}_{R}$” is returned from the FP series PLC on the other end as the response when the program is executed. The received data is stored in the data registers as shown below.



Extracting the data register values from the PLC on the other end

In the program, the data segment of the response from the PLC on the other end is converted to hexadecimal data using the **F72 (AHEX)** (hexadecimal ASCII → hexadecimal data conversion) instruction and stored in DT50 and DT51, only if the character string "$1" stored in DT1 is detected as a comparison instruction.



If an error occurs, "%01!OO□□ C_R" is returned as the response (OO is the error code and □□ is the BCC).

10.4 Data Format

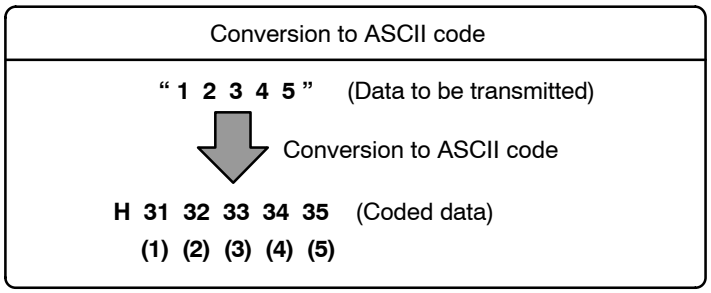
Remember the following when accessing data in the FPΣ send and receive buffers:

- Data in the send and receive buffers, that is being sent and received, is in ASCII code.
- If a header has been chosen in the transmission format settings, the code STX (H02) will automatically be added at the beginning of the data being sent.
- A terminator is automatically added to the end of the data being sent.
- There is no terminator on the data stored in the receive buffer.

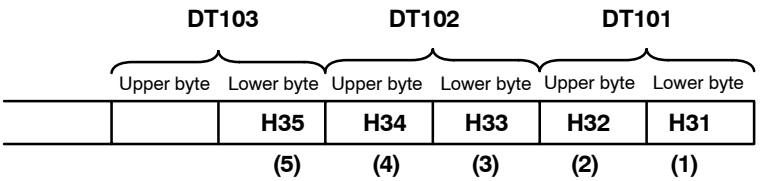
Sending data:
Data written to the send buffer will be sent just as it is.

Example: **The data "12345" is transmitted as an ASCII code to a device with RS232C port.**

Data sent using the F95 (ASC) instruction should be converted to ASCII code data.



If DT100 is being used as the send buffer, data will be stored in sequential order in the data registers starting from the next register (DT101), in two–byte units consisting of the upper and the lower byte.

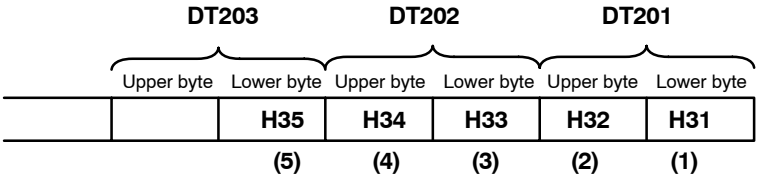


Receiving data:

The data of the receive area being read is ASCII code data.

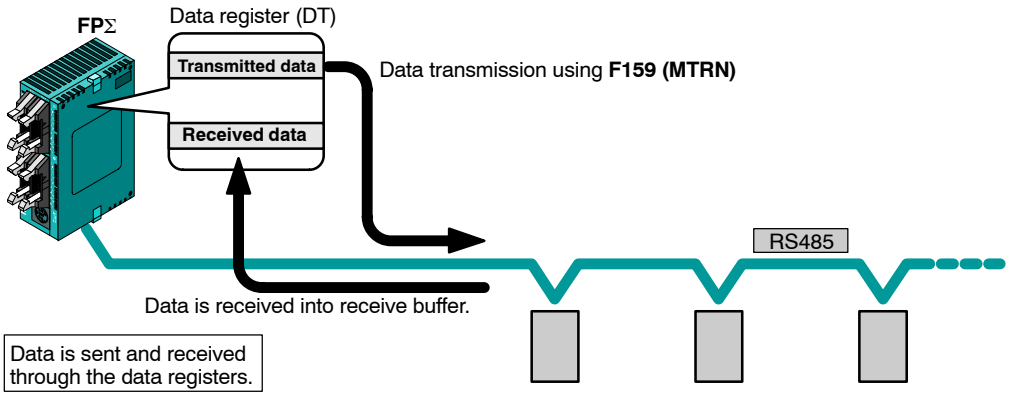
Example: **The data "12345$^{C}_{R}$" is transmitted from a device with RS232C port.**

If DT200 is being used as the receive buffer, received data will be stored in the registers starting from DT201, in sequential order of first the lower byte and then the upper byte.



10.5 1:N Communication

The FPΣ and the external units are connected using an RS485 cable. Using the protocol that matches the external units, the **F159 (MTRN)** instruction is used to send and receive data.



Communication cassette

The following communication cassette can be used with 1:N general–purpose serial communication.

Name	Description	Part No.
FPΣ communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1:N computer links (C–NET), general–purpose serial communication, and PLC link.	FPG–COM3

System Register Settings

For 1:N general–purpose serial communication, the system registers should be set as shown below.

- Settings for COM port 1

No.	Name	Set value
No. 410	Unit no.	1 to 32 (Set the desired unit no.)
No. 412	Communication mode for COM port 1	General–purpose serial communication
No. 413	Communication format for COM port 1	Data length: . . . . . 8 bits Parity check: . . . . . Odd Stop bit: . . . . . 1 bit Terminator: . . . . . CR Header: . . . . . No STX
No. 415	Baud rate setting	9600 bps
No. 416	Starting address for receive buffer	Set the desired address.
No. 417	Receive buffer capacity	Set the desired capacity (max. 2,048 bytes).

The transmission format and baud rate (transmission speed) should be set to match the connected devices.

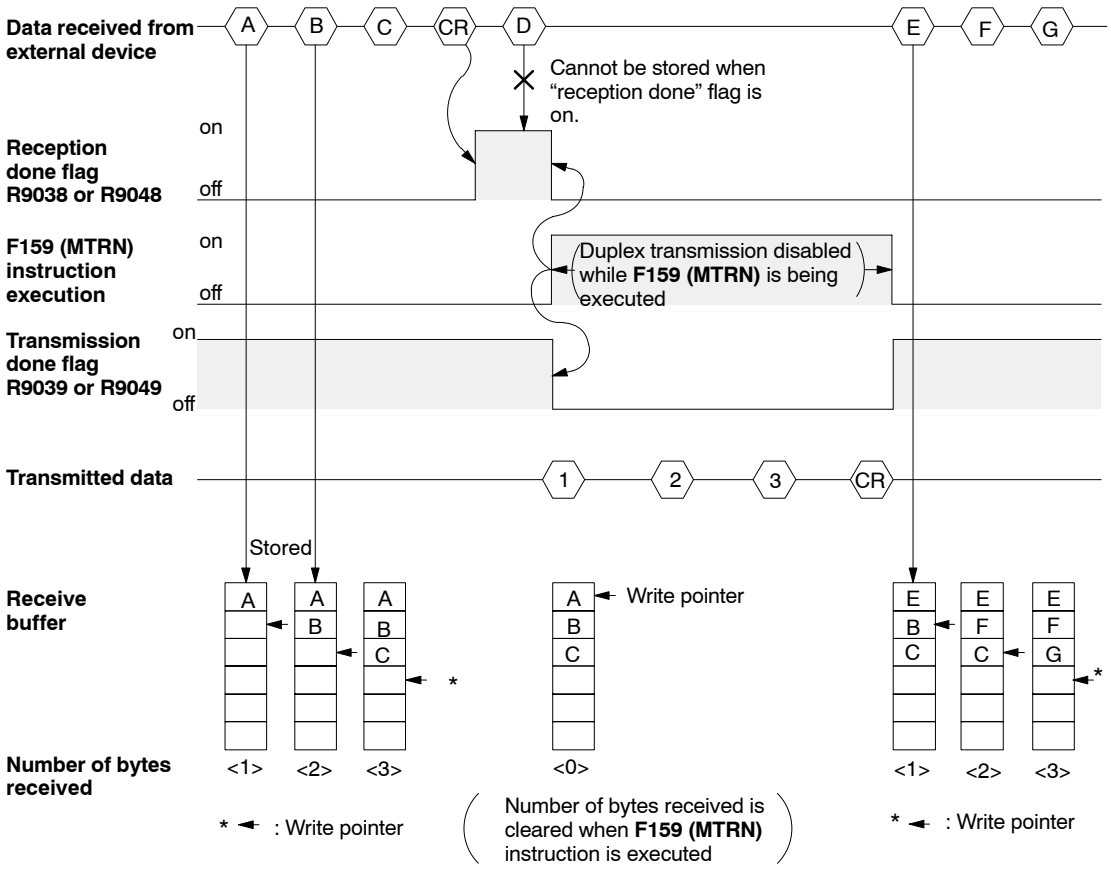
10.6 Flag Operation in Serial Communication

This section explains the operation of the “reception done” and the “transmission done” flag in serial communication.

10.6.1 Header: No–STX, Terminator: CR

Receiving data:

The “reception done” flag, the “transmission done” flag, and the **F159 (MTRN)** instruction are related as follows:



For general–purpose serial communication, half–duplex transmission must be used. Reception is disabled when the “reception done” flag R9038 or R9048 is on.

When **F159 (MTRN)** is executed, the number of bytes received is cleared, and the address (write pointer) in the receive buffer is reset to the initial address.

Also, when **F159 (MTRN)** is executed, the error flag R9037 or R9047, the “reception done” flag R9038 or R9048 and the “transmission done” flag R9039 or R9049 go off.

Duplex transmission is disabled while **F159 (MTRN)** is being executed. The “transmission done” flag R9039 or R9049 must be observed.

Reception stops if the error flag R9037 or R9047 goes on. To resume reception, execute the **F159 (MTRN)** instruction, which turns off the error flag.

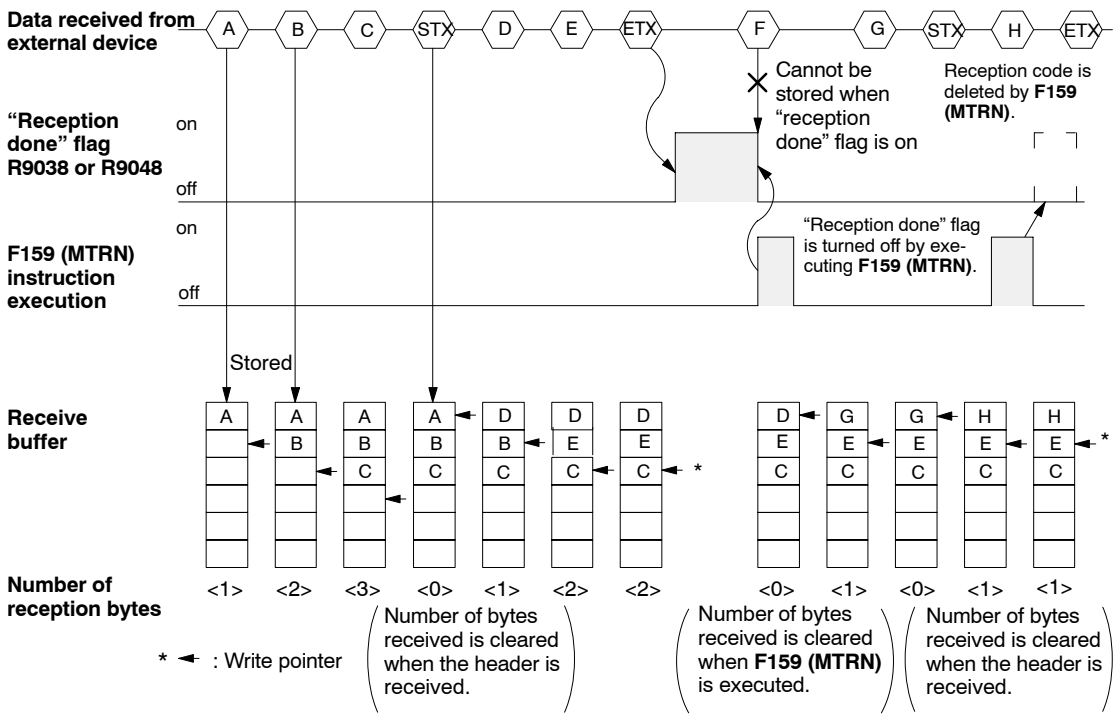
Note

Be aware that the "reception done" flag R9038 or R9048 changes even while a scan is in progress (e.g., if the "reception done" flag is used multiple times as an input condition, there is a possibility of different statuses existing within the same scan). To prevent multiple read access to the special internal relay you should generate a copy of it at the beginning of the program.

10.6.2 Header: STX, Terminator: ETX

Receiving data:

The "reception done" flag, the "transmission done" flag, and the **F159 (MTRN)** instruction are related as follows:



The data is stored in the receive buffer in sequential order. When the header is received, the number of bytes received is cleared, and the address (write pointer) in the receive buffer is reset to the initial address.

Reception is disabled while the "reception done" flag R9038 or R9048 is on.

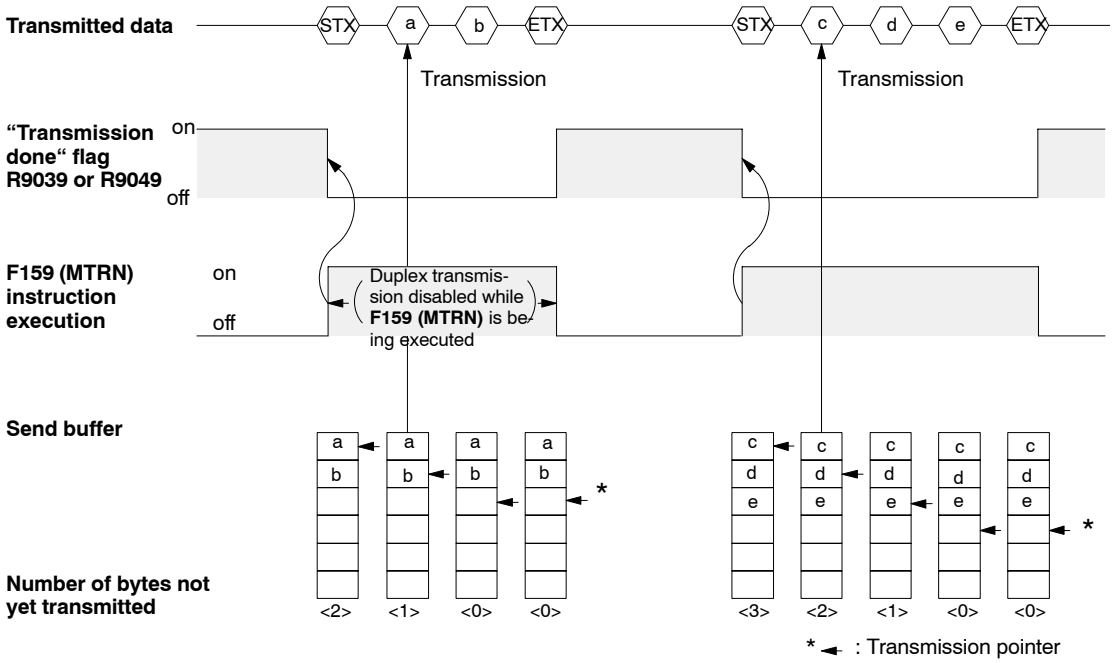
Also, when **F159 (MTRN)** is executed, the number of bytes received is cleared, and the address (write pointer) in the receive buffer is reset to the initial address.

If there are two headers, data following the second header overwrites the data in the receive buffer.

The “reception done” flag R9038 or R9048 is turned off by the **F159 (MTRN)** instruction. Therefore, if **F159 (MTRN)** is executed at the same time the terminator is received, the “reception done” flag will not be detected.

Sending data:

The “reception done” flag, the “transmission done” flag, and the **F159 (MTRN)** instruction are related as follows:



Header (STX) and terminator (ETX) are automatically added to the data being transmitted. The data is transmitted to an external device.

When the **F159 (MTRN)** instruction is executed, the “transmission done” flag R9039 or R9049 goes off.

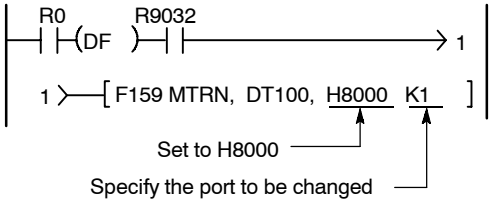
Duplex transmission is disabled while **F159 (MTRN)** is being executed. The “transmission done” flag R9039 or R9049 must be observed.

10.7 Changing Communication Mode of COM Port

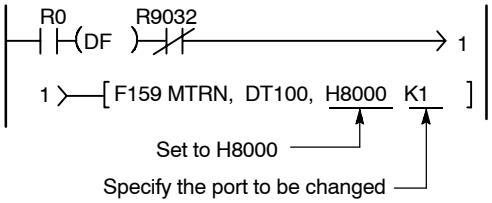
An **F159 (MTRN)** instruction can be executed to change between general–purpose serial communication mode and computer link mode. To do so, specify H8000 for n (the number of transmission bytes) and execute the instruction.

FPWIN GR:

Changing from “general–purpose” to “computer link”



Changing from “computer link” to “general–purpose“



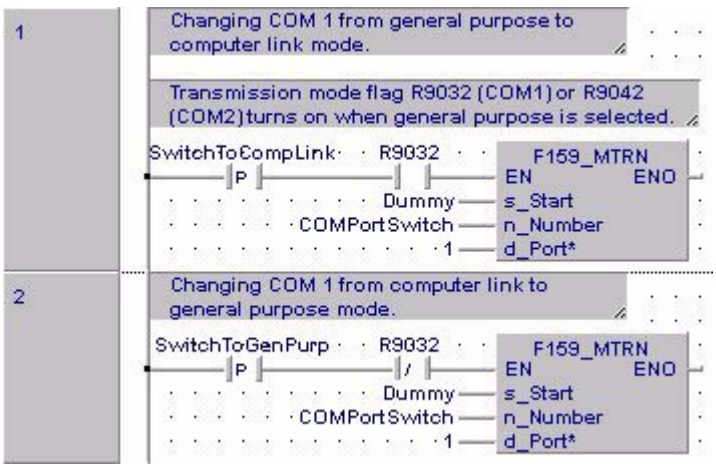
The RS232C port selection flag in R9032 or R9042 turns on when general–purpose serial communication mode is selected.

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	SwitchToCompLink	BOOL	FALSE	
1	VAR	Dummy	WORD	0	
2	VAR	COMPortSwitch	WORD	16#8000	Switches System Register 412 from computer link to general port or vice versa.
3	VAR	SwitchToGenPurp	BOOL	FALSE	

LD Body



Note

When the power is turned on, the operating mode selected in system register no. 412 takes effect.

Chapter 11

PLC Link

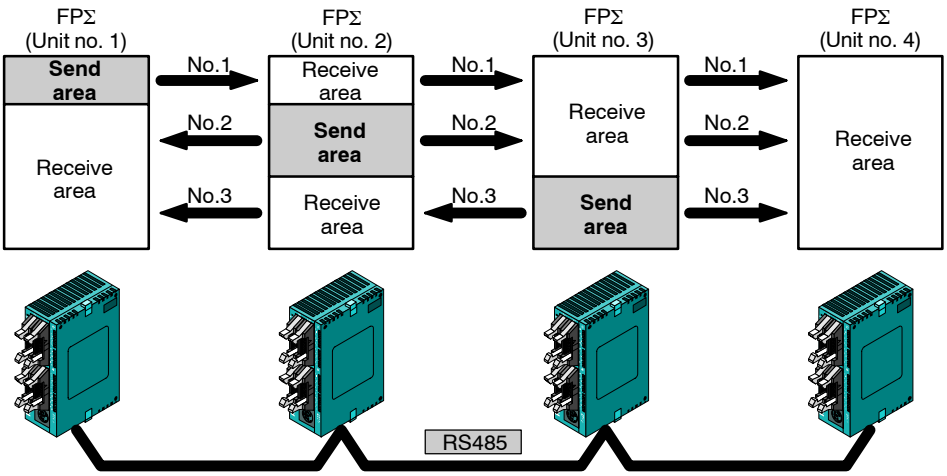
11.1 Overview

The PLC link is an economic way of linking PLCs, using a twisted–pair cable. Data is shared between the PLCs using link relays (L) and link registers (LD). The statuses of the link relays and link registers of one PLC are automatically fed back to the other PLCs on the same network.

PLC link is not the default setting. Therefore, the setting of system register no. 412 must be changed to “PLC Link” in order to use this function.

The link relays and link registers of the PLCs contain areas for sending and areas for receiving data. These areas are used to share data among the PLCs. Turning on a link relay contact in one PLC turns on the same link relay in all other PLCs on the same network. Likewise, if the contents of a link register in one PLC are changed, the values of the same link register are changed in all PLCs on the same network.

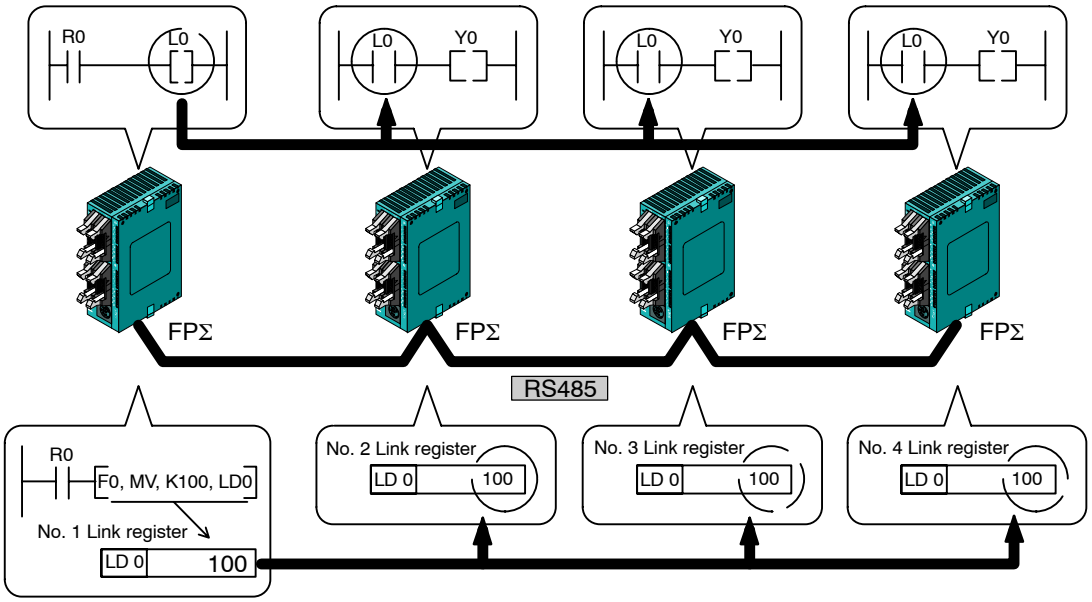
Unit numbers and link areas are allocated using the system registers.



Example:

Link relay L0 for unit no. 1 is turned on. The status change is fed back to the programs of the other units, and Y0 of the other units is set to TRUE.

A constant of 100 is written to link register LD0 of unit no. 1. The contents of LD0 in the other units are also changed to a constant of 100.



11.2 Setting Communication Parameters

By default, the COM ports are disabled for communication. Set the communication mode, the unit number, and the link area using the FPWIN Pro or FPWIN GR programming tool.

Note

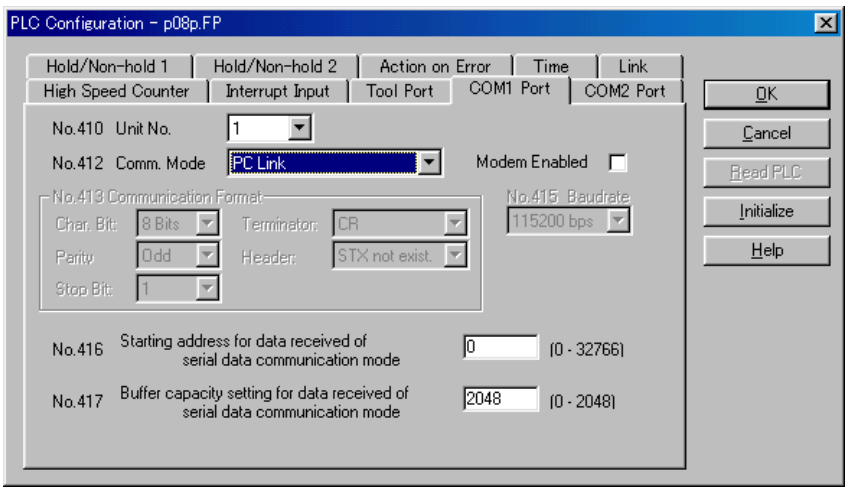
When using a PLC link, the communication format and baud rate are fixed:

- **communication format:**
  - **data length (char. bit) 8 bits**
  - **parity odd**
  - **stop bit 1**
- **baud rate: 115200 bps**

11.2.1 Communication Mode

Procedure for FPWIN GR:

1. **Options –> PLC Configuration**



2. **Select “COM. 1 Port” tab**

   There are separate settings for COM port 1 and COM port 2.

   No. 412 Communication (Comm.) Mode

   Select the COM port operation mode: click on ▼, and select “PC Link”.

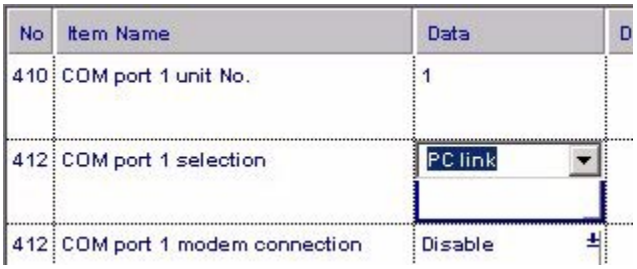
Procedure for FPWIN Pro:

1. **Double–click “PLC” in the project navigator**
2. **Double–click “System Register”**
3. **Double–click “COM Port”**

   There are separate settings for COM ports 1 and 2.

   No. 412: COM port 1 selection

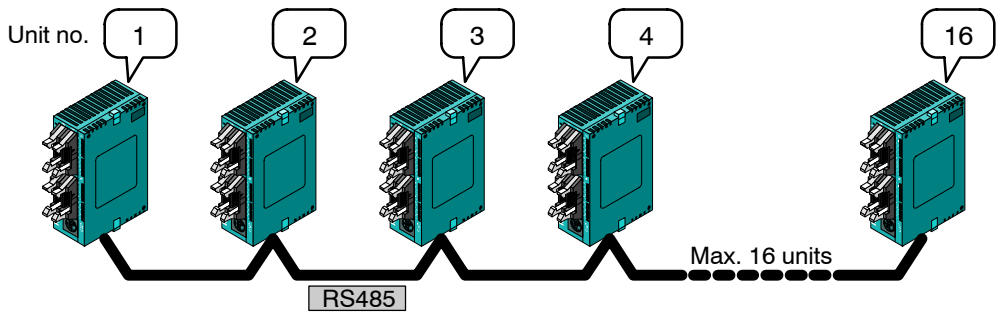
   Select the COM port operation mode: click on ▼, and select “PC Link”.



11.2.2 Unit Numbers

By default, the unit number for the communication port is set to 1 in the system registers.

In a PLC link that connects multiple PLCs on the same transmission line, the unit number must be set in order to identify the different PLCs. The same number must not be used for more than one PLC on the same network.



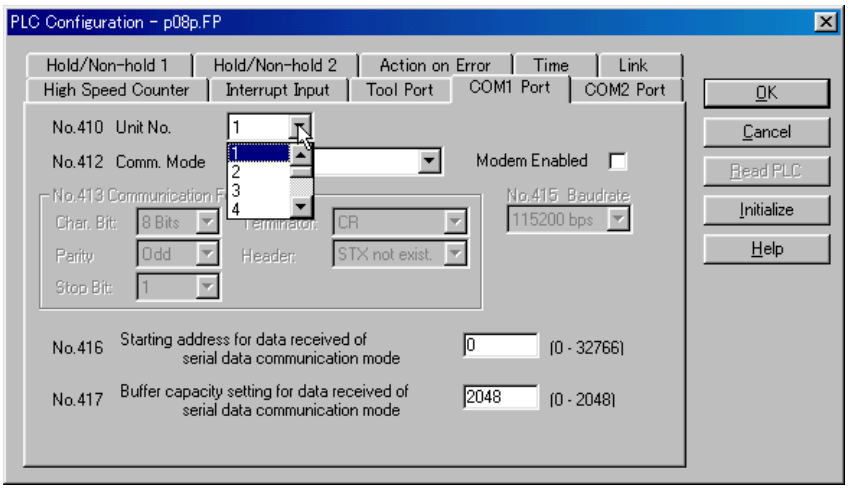
The unit number is specified either by using the system register settings in the FPWIN Pro or FPWIN GR programming tool or the unit number setting switch on the side of the FPΣ control unit. Setting the unit number setting switch to 0 makes the system register settings valid.

Setting unit numbers with the programming software

To set unit numbers with the FPWIN Pro or FPWIN GR programming software, follow the procedure below.

Procedure for FPWIN GR:

1. **Option –> PLC Configuration**

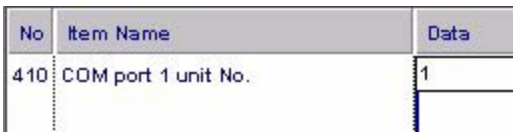


2. **No. 410 Unit no. setting (for COM port 1)**

   Click on ▼, and select a unit number from 1 to 16.

Procedure for FPWIN Pro:

1. **Double–click “PLC” in the project navigator**
2. **Double–click “System Register”**
3. **Double–click “COM Port”**
4. **Enter a unit number from 1 to 16 in system register no. 410 (for COM port 1)**



Setting unit numbers with the setting switch

The unit number setting switch is located underneath the cover on the left side of the FPΣ control unit. The selector switch and the dial can be used in combination to set a unit number between 1 and 16.

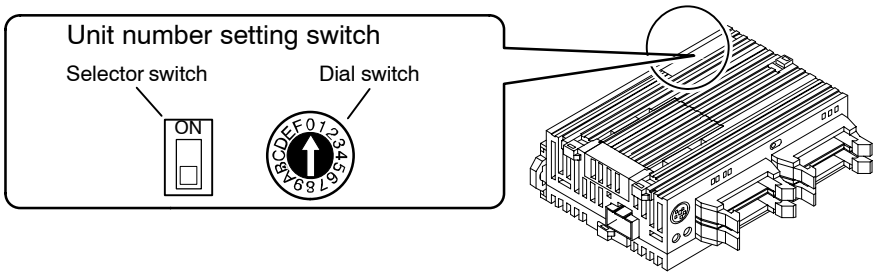


Table of switch settings and related unit numbers

Dial switch position	Unit number	
	Selector switch: off	Selector switch: on
0	—	16
1	1	Not available
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
A	10	
B	11	
C	12	
D	13	
E	14	
F	15	

Notes

- **To enable the unit number setting in FPWIN Pro or FPWIN GR, set the unit number setting switch to 0.**
  If the station number setting switch has been set to 0, the system register settings and SYS1 instruction setting become valid.
- **When using the PLC link function, the maximum number of units is 16.**
- **Station numbers should be set sequentially and consecutively, starting from 1, with no breaks between them. If there is a missing station number, the transmission time will be longer.**

- **If fewer than 16 units are linked, the transmission time can be shortened by setting the largest station number in system register no. 47.**
- **Station numbers can also be set using the SYS1 instruction.**
- **The priority order for station number settings is as follows:**
  1. station number setting switch
  2. system registers
  3. SYS1 instruction

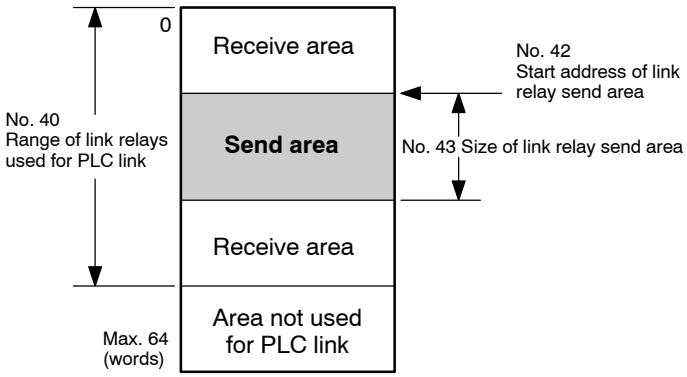
11.2.3 Link Area Allocation

The PLC link function is a function that involves all PLCs that have been booted in the MEWNET–W0 mode. To use the PLC link function, a link area needs to be allocated. Set the allocations for both the link relays and link registers.

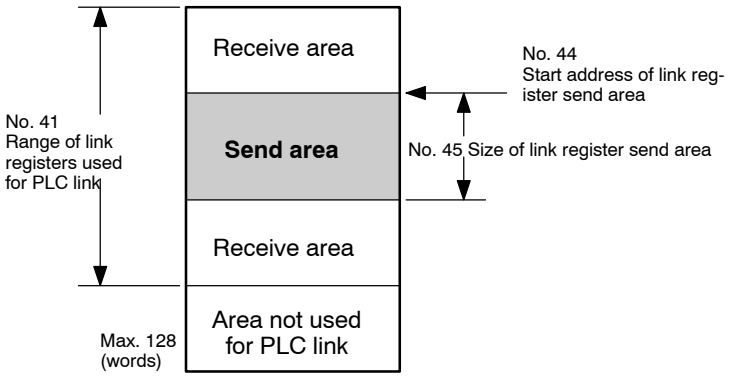
Link area allocations are specified using the system registers:

No.	Name	Set value
No. 40	Range of link relays used for PLC link	0 to 64 words
No. 41	Range of link registers used for PLC link	0 to 128 words
No. 42	Start address of link relay send area	0 to 63
No. 43	Size of link relay send area	0 to 64 words
No. 44	Start address of link register send area	0 to 127
No. 45	Size of link register send area	0 to 127 words

Link relay allocation



Link register allocation


Receive area
No. 44
Start address of link register send area
No. 41
Range of link registers used for PLC link
Send area
No. 45 Size of link register send area
Receive area
Area not used for PLC link
Max. 128 (words)

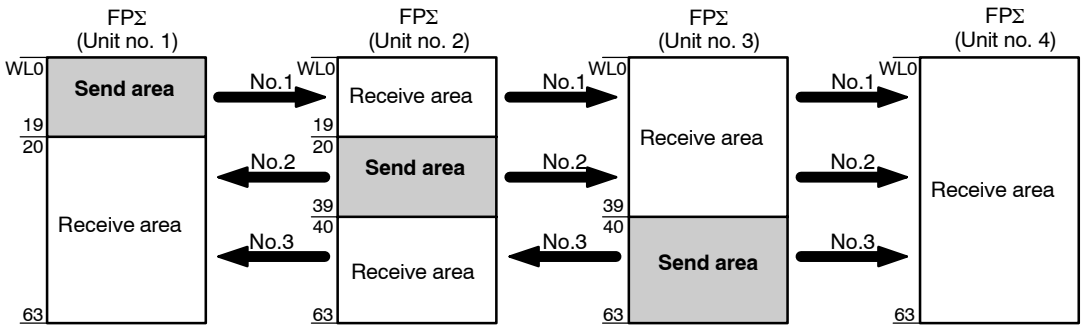
Note

Link areas consist of link relays and link registers for PLC link and are used with the respective control units. A maximum of 1024 link relays (points) and 128 link registers (words) can be used in a PLC link area.

11.2.3.1 Example

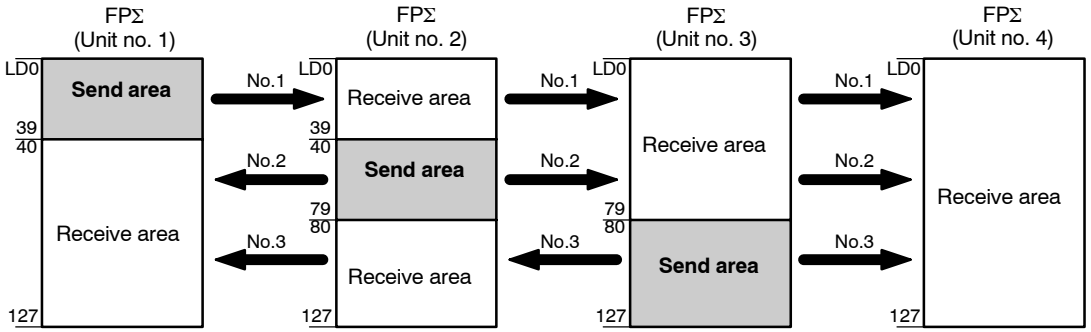
The PLC link areas are divided into send and receive areas. The link relays and link registers are transmitted from the send area to the receive area of a different FPΣ. The link relays and registers in the receive area on the receiving side must be within the same area as on the sending side.

Link relay allocation



System register no.	Name	Set value of various control units			
		No. 1	No. 2	No. 3	No. 4
No. 40	Range of link relays used for PLC link	64	64	64	64
No. 42	Start address of link relay send area	0	20	40	0
No. 43	Size of link relay send area	20	20	24	0

Link register allocation



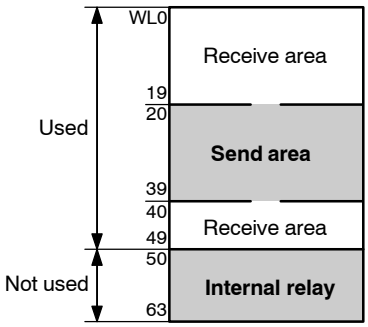
System register no.	Name	Set value of various control units			
		No. 1	No. 2	No. 3	No. 4
No. 41	Range of link registers used for PLC link	128	128	128	128
No. 44	Start address of link register send area	0	40	80	0
No. 45	Size of link register send area	40	40	48	0

When link areas are allocated as shown above, the send area of unit no. 1 can be transmitted to the receive areas of units no. 2, 3, and 4. Also, the receive area of unit no. 1 can receive data from the send areas of units no. 2 and 3. Unit no. 4 is allocated as a receive area only and can receive data from units no. 1, 2, and 3, but cannot send data to other units.

11.2.3.2 Partial Use of Link Areas

In the link areas available for PLC link, link relays with a total of 1,024 points (64 words) and link registers with a total of 128 words can be used. This does not mean, however, that it is necessary to reserve the entire area. Parts of the area which have not been reserved can be used as internal relays and internal registers.

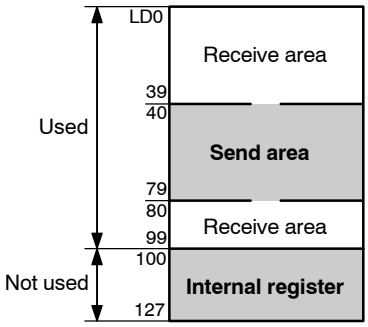
Link relay allocation



No.	Name	No. 1
No. 40	Range of link relays used for PLC link	50
No. 42	Start address of link relay send area	20
No. 43	Size of link relay send area	20

With the above settings, the 14 words (224 points) consisting of WL50 to WL63 can be used as internal relays.

Link register allocation



No.	Name	No. 1
No. 41	Range of link registers used for PLC link	100
No. 44	Start address of link register send area	40
No. 45	Size of link register send area	40

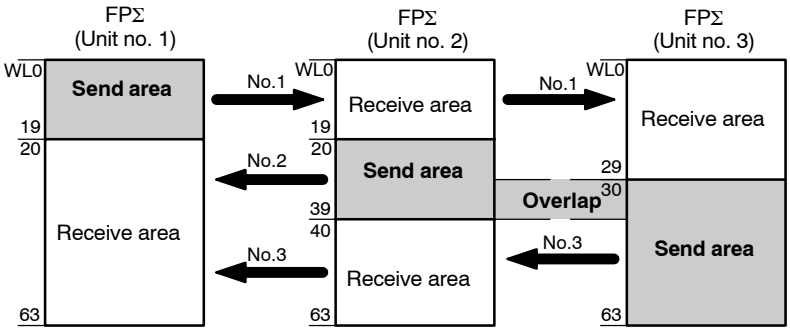
With the above settings, the 28 words consisting of LD100 to LD127 can be used as internal registers.

11.2.3.3 Precautions

A mistake in the link area allocation will cause an error, and communication will be disabled.

Avoid overlapping send areas

When sending data from the send area to the receive area of another FPΣ, send and receive areas must match. In the example shown below, there is an overlapping area between units no. 2 and 3, and this will cause an error, so that communication cannot be carried out.

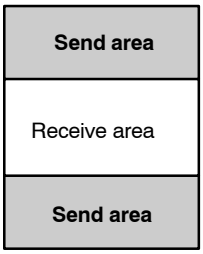


System register no.	Name	Set value of various control unit		
		No. 1	No. 2	No. 3
No. 40	Range of link relays used for PLC link	64	64	64
No. 42	Start address of link relay send area	0	20	30
No. 43	Size of link relay send area	20	20	34

Invalid allocations

The allocations shown below are not possible, neither for link relays nor for link registers:

– Send area is split



– Send and receive areas are split into multiple segments



11.2.4 Setting the Largest Station Number for a PLC Link

The largest station number can be set using system register no. 47.

Sample settings

No. of units linked	Setting contents
2	1st unit: station no. 1 is set 2nd unit: station no. 2 is set A largest station no. of 2 is set for each.
4	1st unit: station no. 1 is set 2nd unit: station no. 2 is set 3rd unit: station no. 3 is set 4th unit: station no. 4 is set A largest station no. of 4 is set for each.
n	Nth unit: station no. n is set A largest station no. of N is set for each.

Notes

- **Station numbers should be set sequentially and consecutively, starting from 1, with no breaks between them. If there is a missing station number, the transmission time will be longer.**
- **If fewer than 16 units are linked, the transmission time can be shortened by setting the largest station number in system register no. 47.**
- **For all PLCs which are linked, the same value should be set for the largest station number.**
- **If there are fewer than 16 units linked and the largest station number has not been set (default = 16), or the largest station number has been set but the station number settings are not consecutive, or the station number settings are consecutive but there is a station for which the power supply has not been turned on, the response time for the PLC link (the link transmission cycle) will be longer. For further information, please refer to page 11-18, “PLC Link Response Time”.**

11.3 Monitoring

When using a PLC link, the operation status of the links can be monitored using the following relays.

Transmission assurance relays R9060 to R906F (correspond to station no.1 to 16)

If the transmission data from a different station is being used with the various PLCs, check to make sure the transmission assurance relay for the target station is on before using the data.

Relay no.	R9060	R9061	R9062	R9063	R9064	R9065	R9066	R9067	R9068	R9069	R906A	R906B	R906C	R906D	R906E	R906F
Station no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Conditions for on/off	ON: When the PLC link is normal OFF: If transmission is stopped, a problem has occurred, or a PLC link is not being used															

Operation mode relays R9070 to R907F (correspond to station no.1 to 16)

The operation modes (RUN/PROG.) can be checked for any given PLC.

Relay no.	R9070	R9071	R9072	R9073	R9074	R9075	R9076	R9077	R9078	R9079	R907A	R907B	R907C	R907D	R907E	R907F
Station no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Conditions for on/off	ON: When the unit is in the RUN mode OFF: When the unit is in the PROG. mode															

PLC link transmission error relay R9050

This relay goes on if a problem is detected during transmission.

Relay No.	R9050															
Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Conditions for on/off	ON: When a transmission error has occurred in the PLC link, or when there is an error in the setting for the PLC link area OFF: When there are no transmission errors															



Tip

Monitoring the PLC link status

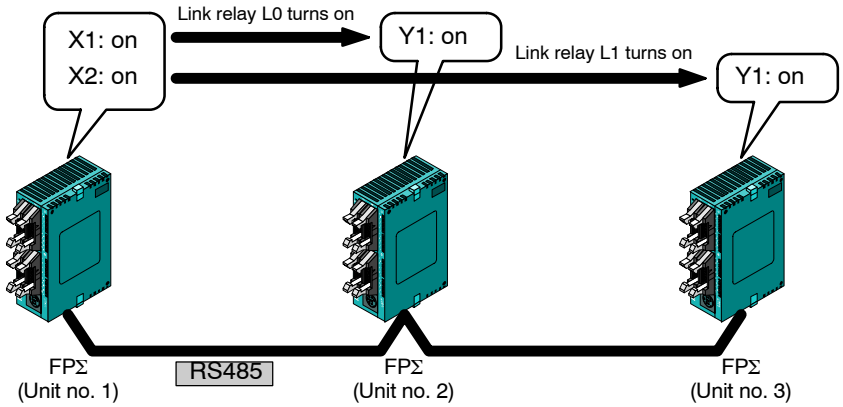
In FPWIN Pro, the PLC link status items, such as the transmission cycle time and the number of times that errors have occurred, can be monitored by choosing **Monitor –> PLC Link Status**. In FPWIN GR, select the PLC link switch on the FPWIN GR Status Monitor screen.

 **Note**

Remote programming of other linked PLCs is not possible.

11.4 Connection Example

The following example demonstrates how the PLC can be connected to two other FPΣ PLCs using a PLC link connection. In the example shown here, link relays are used. When X1 of control unit no. 1 turns on, Y1 of unit no. 2 turns on. When X2 of unit no. 1 turns on, Y1 of unit no. 3 turns on.



Communication cassette

The following communication cassette can be used with the PLC link function:

Name	Description	Part no.
FPΣ communication cassette 1–channel RS485 type	This communication cassette is a 1–channel unit with a two–wire RS485 port. It supports 1 : N computer links (C–NET), general–purpose serial communication, and a PLC link.	FPG–COM3

System register settings

When using a PLC link, the transmission format and baud rate are fixed (see page 11-4).

Set communication mode and unit numbers using the system registers:

- Settings for unit no. 1

No.	Name	Set value
No. 410	COM port 1 unit no.	1
No. 412	COM port 1 selection of communication mode	PC link

- Settings for unit no. 2

No.	Name	Set value
No. 410	COM port 1 unit no.	2
No. 412	COM port 1 selection of communication mode	PC link

- Settings for unit no. 3

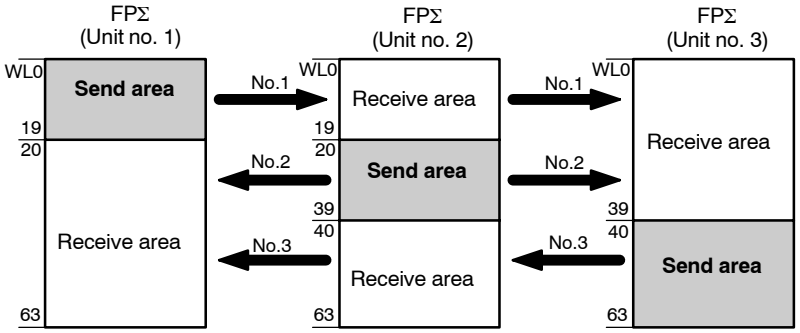
No.	Name	Set value
No. 410	COM port 1 unit no.	3
No. 412	COM port 1 selection of communication mode	PC link

Note

Make sure the same unit number is not used for more than one of the PLCs connected through the PLC link function.

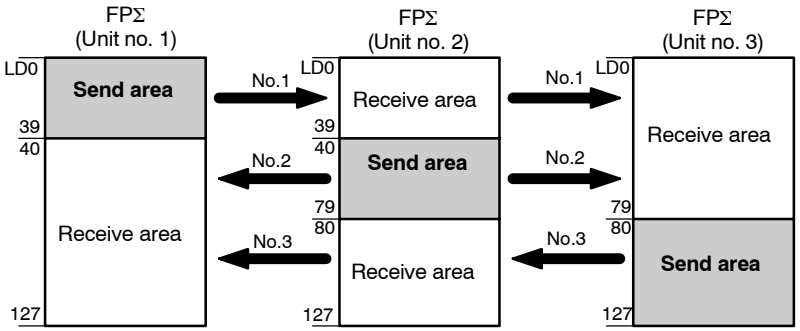
Link area allocation

• Link relay allocation



System register no.	Name	Set value of various control units		
		No. 1	No. 2	No. 3
No. 40	Range of link relays used for PLC link	64	64	64
No. 42	Start address of link relay send area	0	20	40
No. 43	Size of link relay send area	20	20	24

• Link register allocation

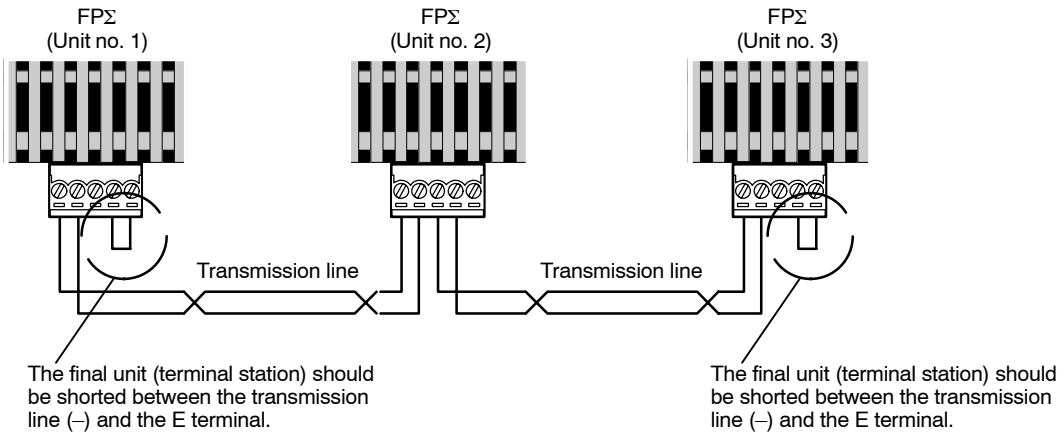


System register no.	Name	Set value of various control units		
		No. 1	No. 2	No. 3
No. 41	Range of link registers used for PLC link	128	128	128
No. 44	Start address of link register send area	0	40	80
No. 45	Size of link register send area	40	40	48

• Setting the largest station number

No.	Name	Set value of various control unit		
		No. 1	No. 2	No. 3
No. 47	Largest station number setting for PLC link	3	3	3

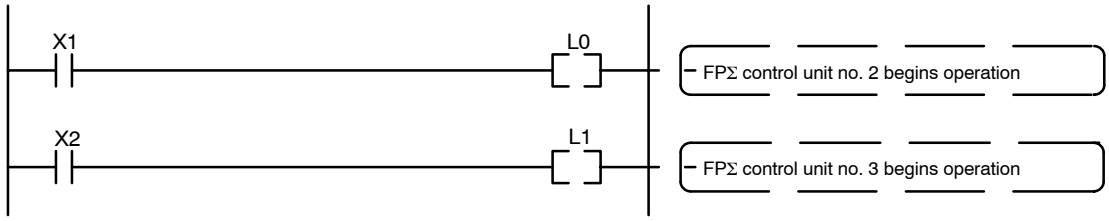
Connection diagram


FPΣ
(Unit no. 1)
FPΣ
(Unit no. 2)
FPΣ
(Unit no. 3)
Transmission line
Transmission line
The final unit (terminal station) should be shorted between the transmission line (–) and the E terminal.
The final unit (terminal station) should be shorted between the transmission line (–) and the E terminal.

Programs

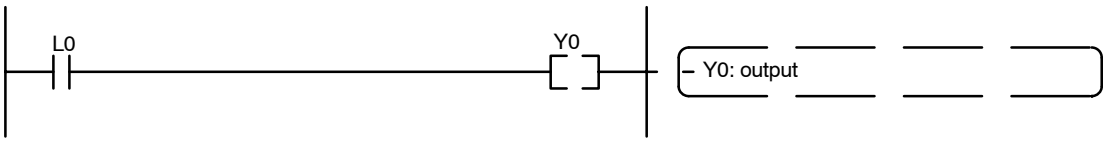
• Unit no. 1

When X1 is input, L0 of the link relay goes on, and when X2 is input, L1 of the link relay goes on.



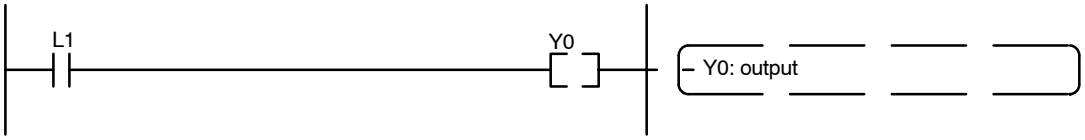
• Unit no. 2

When L0 of the link relay goes on, Y0 is output.



• Unit no. 3

When L1 of the link relay goes on, Y1 is output.



Note

If you are using FPWIN Pro and wish to use the addresses LD or LE, please enter "LOD" or "LOE" to avoid error messages during compilation. The errors arise due to hexadecimal conflicts with the commands Load (LD) or Less Than or Equal To (LE).

11.5 PLC Link Response Time

The maximum value for the transmission time (T) of one cycle can be calculated using the following formula.

T max. = Ts1 + Ts2 + – – – – + Tsn + Tlt + Tso + Tlk

① Ts (transmission time per station)

② Tlt (link table sending time)

③ Tso (master station scan time)

④ Tlk (link addition processing time)

The various items in the formula are calculated as described below.

① Ts (transmission time per station)

Ts = scan time + Tpc (PLC link sending time)
Tpc = Ttx (sending time per byte) x Pcm (PLC link sending size)
Ttx = 1 / transmission speed x 1000 x 11 ms —— approx. 0.096 ms at 115.2 kbps
Pcm = 23 + (number of relay words + number of register words) x 4

② Tlt (link table sending time)

Tlt = Ttx (sending time per byte) x Ltm (link table sending size)
Ttx = 1 / transmission speed x 1000 x 11 ms —— approx. 0.096 ms at 115.2 kbps
Ltm = 13 + 2 x n (n = number of stations being added)

③ Tso (master station scan time)

This should be confirmed using the programming tool.

④ Tlk (link addition processing time) —— If no stations are being added, Tlk = 0.

Tlk = Tlc (link addition command sending time) + Twt (addition waiting time) + Tls (sending time for command to stop transmission if link error occurs) + Tso (master station scan time)
Tlc = 10 x Ttx (sending time per byte)
Ttx = 1 / transmission speed x 1000 x 11 ms —— approx. 0.096 ms at 115.2 kbps
Twt = Initial value 400 ms (can be changed using SYS1 system register instruction)
Tls = 7 x Ttx (sending time per byte)
Ttx = 1 / transmission speed x 1000 x 11 ms —— approx. 0.096 ms at 115.2 kbps
Tso = Master station scan time

Calculation example 1

When all stations have been added to a 16–unit link, the largest station number is 16, relays and registers have been evenly allocated, and the scan time for each PLC is 1 ms

Ttx = 0.096 Each Pcm = 23 + (4 + 8) x 4 = 71 Tpc = Ttx x Pcm = 0.096 x 71 ≒ 6.82 ms
Each Ts = 1 + 6.82 = 7.82 ms Tlt = 0.096 x (13 + 2 x 16) = 4.32 ms
Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 7.82 x 16 + 4.32 + 1 = 130.44 ms

Calculation example 2

When all stations have been added to a 16–unit link, the largest station number is 16, relays and registers have been evenly allocated, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Pcm = 23 + (4 + 8) x 4 = 71 Tpc = Ttx x Pcm = 0.096 x 71 ≒ 6.82 ms
Each Ts = 5 + 6.82 = 11.82 ms Tlt = 0.096 x (13 + 2 x 16) = 4.32 ms
Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:
T max. = 11.82 x 16 + 4.32 + 5 = 198.44 ms

Calculation example 3

When all but one station have been added to a 16–unit link, the largest station number is 16, relays and registers have been allocated evenly, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Ts = 5 + 6.82 = 11.82 ms Tlt = 0.096 x (13 + 2 x 15) ≒ 4.31 ms

Tlk = 0.96 + 400 + 0.67 + 5 ≒ 407 ms

Note: The default value for the addition waiting time is 400 ms.

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 11.82 x 15 + 4.13 + 5 + 407 = 593.43 ms

Calculation example 4

When all stations have been added to an 8–unit link, the largest station number is 8, relays and registers have been evenly allocated, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Pcm = 23 + (8 + 16) x 4 = 119 Tpc = Ttx x Pcm = 0.096 x 119 ≒ 11.43 ms

Each Ts = 5 + 11.43 = 16.43 ms Tlt = 0.096 x (13 + 2 x 8) ≒ 2.79 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 16.43 x 8 + 2.79 + 5 = 139.23 ms

Calculation example 5

When all stations have been added to a 2–unit link, the largest station number is 2, relays and registers have been evenly allocated, and the scan time for each PLC is 5 ms

Ttx = 0.096 Each Pcm = 23 + (32 + 64) x 4 = 407 Tpc = Ttx x Pcm = 0.096 x 407 ≒ 39.072 ms

Each Ts = 5 + 39.072 = 44.072 ms Tlt = 0.096 x (13 + 2 x 2) ≒ 1.632 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 44.072 x 2 + 1.632 + 5 = 94.776 ms

Calculation example 6

When all stations have been added to a 2–unit link, the largest station number is 2, 32 relays and 2 register words have been evenly allocated, and the scan time for each PLC is 1 ms

Ttx = 0.096 Each Pcm = 23 + (1 + 1) x 4 = 31 Tpc = Ttx x Pcm = 0.096 x 31 ≒ 2.976 ms

Each Ts = 1 + 2.976 = 3.976 ms Tlt = 0.096 x (13 + 2 x 2) ≒ 1.632 ms

Given the above conditions, the maximum value for the transmission time (T) of one cycle will be:

T max. = 3.976 x 2 + 1.632 + 1 = 10.584 ms

Notes

- **In the description, “stations that have been added” refers to stations which are connected between station no. 1 and the largest station number and for which the power supply has been turned on.**
- **Comparing examples 2 and 3, the transmission cycle time is longer if there is one station that has not been added to the link. As a result the PLC link response time is longer.**
- **The SYS1 instruction can be used to minimize the transmission cycle time even if there are one or more stations that have not been added to the link.**

11.5.1 Reducing the Transmission Cycle Time

If there are stations that have not been added to the link, the Tlk time (link addition processing time) and with this the transmission cycle time will be longer.

$$T\ max. = Ts1 + Ts2 + \cdots + Tsn + Tlt + Tso + \underline{Tlk}$$

Tlk = Tlc (link addition command sending time) + Twt (addition waiting time) + Tls (link error stop command sending time) + Tso (master station scan time)

With the SYS1 instruction, the link addition waiting time Twt in the above formula can be reduced. Thus, SYS1 can be used to minimize the increase in the transmission cycle time.

Programming example: Setting SYS1 to change the waiting time for a link to be added to the PLC link from the default value of 400 ms to 100 ms.

FPWIN GR:

SYS1 MPCLK1T0, 100

Key words: Setting for key word no. 1: PCLK1T0

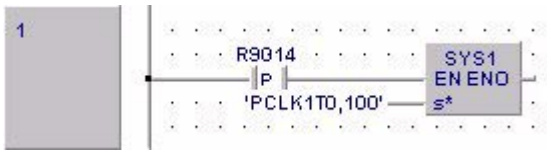
Permissible range for key word no. 2: 10 to 400 (10 ms to 400 ms)

FPWIN Pro:

POU Header

Since Matsushita addresses and strings are entered directly instead of using variables, no POU header is required.

LD Body



Notes

- **The SYS1 instruction should be executed at the beginning of the program, at the rise of R9014. The same waiting time should be set for all linked PLCs.**
- **Executing SYS1 does not change any of the system registers.**
- **The waiting time should be set to a value of at least twice the maximum scan time for any of the PLCs connected to the link.**
- **If a short waiting time has been set, there may be PLCs that cannot be added to the link even if their power supply is on. (The shortest time that can be set is 10 ms.)**

- **If there are any stations that have not been added to the link, the setting should not be changed as long as a longer link transmission cycle time does not cause any problems.**

11.5.2 Error Detection Time for Transmission Assurance Relays

If the power supply of any given PLC fails or is turned off, it takes (as a default value) 6.4 seconds for the transmission assurance relay of that PLC to be turned off at the other stations. This time period can be shortened using the SYS1 instruction.

Programming example: Setting SYS1 to change the time that the PLC link transmission assurance is off from the default value of 6.4 s to 100 ms.

FPWIN GR:

SYS1 MPCLK1T1, 100

Key words: Setting for key word no. 1: PCLK1T1

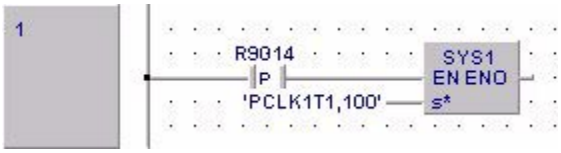
Permissible range for key word no. 2: 100 to 6400 (100 ms to 6400 ms)

FPWIN Pro:

POU Header

Since Matsushita addresses and strings are entered directly instead of using variables, no POU header is required.

LD Body



Notes

- **The SYS1 instruction should be executed at the beginning of the program, at the rise of R9014. The same time should be set for all linked PLCs.**
- **Executing SYS1 does not change any of the system registers.**
- **The time should be set to a value of at least twice the maximum transmission cycle time when all of the PLCs are connected to the link.**
- **If a short time has been set, the transmission assurance relay may not function properly. (The shortest time that can be set is 100 ms.)**
- **The setting should not be changed as long as a longer transmission assurance relay detection time does not cause any problems.**

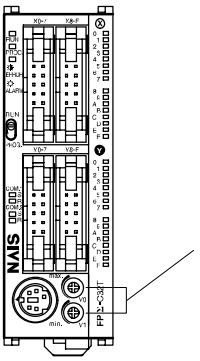
Chapter 12

Other Functions

12.1 Analog Potentiometer

The FPΣ is equipped with two analog potentiometers as a standard feature. Turning the potentiometers changes the values of special data registers DT90040 and DT90041 within a range of K0 to K1000.

With this function it is possible to change internal time settings in the PLC without using the programming tool. The analog values set with the potentiometers can be used in analog clocks and other applications.



Analog potentiometer
V0 (potentiometer 0):Changes the value of DT90040 within a range of K0 to K1000.
V1 (potentiometer 1):Changes the value of DT90041 within a range of K0 to K1000.

Applicable special data registers

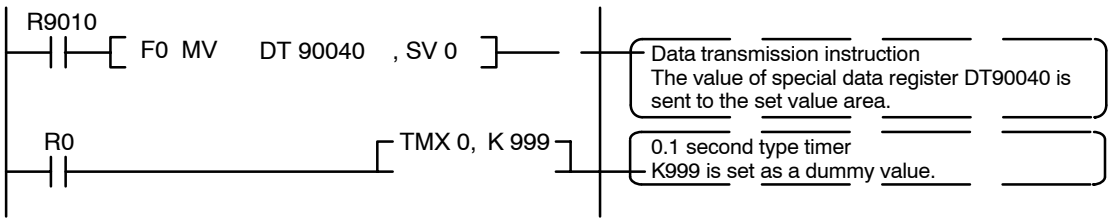
Notation on control unit	Potentiometer no.	Special data register	Range
V0	Volume 0	DT90040	K0 to K1000
V1	Volume 1	DT90041	

12.1.1 Application Example

The data register values set with the potentiometers are sent to the clock set value area. By this a clock is created, that allows time setting via a potentiometer.

The value of special data register DT90040 that corresponds to the analog potentiometer V0 is sent to the set value area (SV) of Timer0 (FPWIN GR: TMX0) to set the clock.

FPWIN GR:

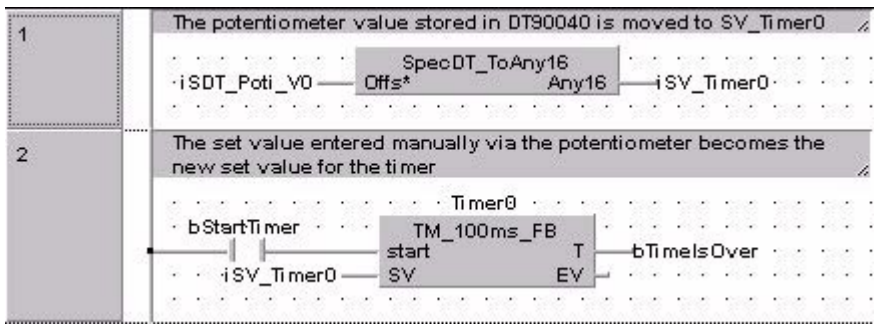

R9010
F0 MV DT 90040 , SV 0
Data transmission instruction
The value of special data register DT90040 is sent to the set value area.
R0
TMX 0, K 999
0.1 second type timer
K999 is set as a dummy value.

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR	iSV_Timer0	INT	0	
1	VAR	Timer0	TM_100ms_FB		
2	VAR	bTimeIsOver	BOOL	FALSE	
3	VAR_CONSTANT	iSDT_Poti_V0	INT	40	Offset to DT90040
4	VAR	bStartTimer	BOOL	FALSE	

LD Body



12.2 Thermistor Input Functions

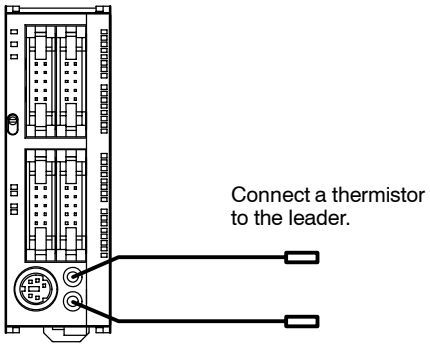
12.2.1 Overview of Thermistor Input

Control units whose part number ends in TM have a leader that accepts thermistor input, in place of analog volume. You can connect a thermistor to this leader, and load changes in the thermistor's resistance as analog input.

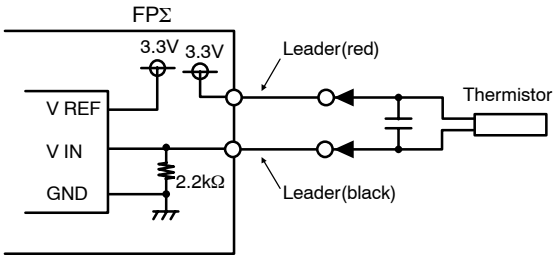
How Thermistor Input is Loaded

Changes in the resistance of an externally connected thermistor are read in as changes in voltage. Then, an AD converter inside the microcomputer is used to load this as a digital value.

The converted digital value can be stored in a special data register (DT90040 or DT90041), and read in by the user program.



Block diagram



The space between the FPΣ thermistor input and power connector (24 V) is insulation; the red side is the 3.3 V power source, and the black side is connected to Vin.

Overall Precision

Overall precision = (overall precision of microcomputer's built–in AD converter: ± 5 LSB*) + (thermistor accuracy)

* ± 5 LSB indicates a margin of error of ± 5 for the post–A/D conversion value (0 to 1,000).

Thermistor Resistance and Digital Conversion Value

The following formula is used to convert the thermistor resistance into a digital value: The digital conversion value varies between K0 and K1000.

$$\text{Digital conversion value} = \frac{1024 \times 2.2}{(\text{Thermistor resistance [k}\Omega\text{]}) + 2.2} - 12$$

Suitable Thermistors

A thermistor with a resistance value of 200Ω to 75kΩ can be used.

Manufacturer	Thermistor Type (B constant)	Measurement range guide (°C)
Shibaura Electronics	3390 K	–50 to +100 °C
	3450 K	0 to +150 °C
	4300 K	+100 to +220 °C
	5133 K	+150 to +300 °C

Notes

Notes on Wiring

- **Make sure the length of the cable between the FPΣ control unit and thermistor is less than 10 m.**
- **Use a thin electrical cable (AWG28, length 150 mm) for the leader. Wire and bundle the electrical cable to avoid undue stress.**
- **If the conversion value does not remain stable, we recommend adding an external capacitor or the like.**

12.2.2 Loading Thermistor Temperature Data

You can load the analog data corresponding to the thermistor resistance by reading in the FPΣ's special data register.

Corresponding Special Data Register

Notation on control unit	Thermistor number	Special data register	Converted digital value
V0	Thermistor 0	DT90040	K0 to K1000
V1	Thermistor 1	DT90041	

Thermistor Measurement Temperature – A/D Conversion Table (Example with 3450 K)

Calculate the relationship between temperature and thermistor resistance using a table with the temperature characteristics of your thermistor.

Use the formula on the preceding page to calculate the post–conversion digital value.

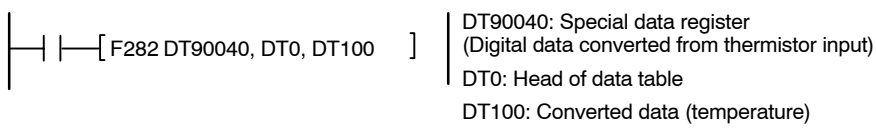
Temperature [°C]	Thermistor resistance [kΩ]	Converted digital value	Resolution [°C]
0	30.0000	58	
10	19.4900	92	0.294
20	12.9700	137	0.222
30	8.8280	192	0.182
40	6.1400	258	0.152
50	4.3560	332	0.135
60	3.1470	409	0.130
70	2.3170	487	0.128
80	1.7340	561	0.135
90	1.3180	628	0.149
100	1.0170	688	0.167
110	0.7940	740	0.192
120	0.6277	785	0.222
130	0.5017	822	0.270
140	0.4052	853	0.323
150	0.3305	878	0.400

The digital values in the table above do not include (overall precision of microcomputer's built–in AD converter: ± 5 LSB*) + (thermistor accuracy)

Conversion program using scaling instruction (F282)

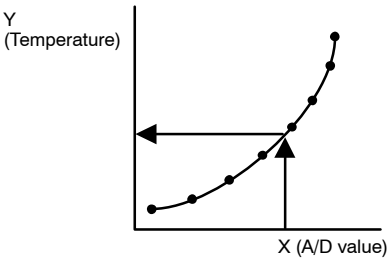
You can run the scaling instruction (F282) to create appropriate interpolated data from non–linear data, as a table of converted digital data and temperatures.

FPWIN GR:


F282 DT90040, DT0, DT100
DT90040: Special data register
(Digital data converted from thermistor input)
DT0: Head of data table
DT100: Converted data (temperature)

Data table example

Input data (converted digital data)		Output data (temperature)	
DT0	16		
DT1	58	DT16	0
DT2	92	DT17	10
DT3	137	DT18	20
•	•	•	•
•	•	•	•
DT15	878	DT30	150



DT0 specifies the number of data pairs +1.

FPWIN Pro:

DUT

Interpolate15 [DUT]

	Identifier	Type	Initial	Comment
0	iReferPoints	INT	15	
1	aiX_values	ARRAY [0..14] OF INT	[58,92,137,11(0),878]	
2	aiY_values	ARRAY [0..14] OF INT	[0,10,20,11(0),150]	

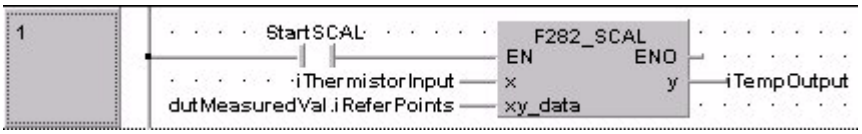
GVL

	Class	Identifier	Matsus	IEC_Address	Type	Initial
0	VAR_GLOBAL	iThermistorInput	DT90040	%MW5.90040	INT	0

POU Header

	Class	Identifier	Type	Initial	Comment
0	VAR_EXTERNAL	iThermistorInput	INT	0	
1	VAR	dutMeasuredVal	Interpolate15		
2	VAR	iTempOutput	INT	0	
3	VAR	StartSCAL	BOOL	FALSE	

LD Body



12.3 Clock/Calendar Function

If a backup battery is installed in the FPΣ, the clock/calendar function can be used.

12.3.1 Area for Clock/Calendar Function

With the clock/calendar function, data indicating the hour, minute, second, day, year and other information stored in the special data registers DT90053 to DT90057 can be read using the transmission instruction and can be used in sequence programs.

Special data register no.	Upper byte	Lower byte	Reading	Writing
DT90053	Hour data H00 to H23	Minute data H00 to H59	Available	Not available
DT90054	Minute data H00 to H59	Second data H00 to H59	Available	Available
DT90055	Day data H01 to H31	Hour data H00 to H23	Available	Available
DT90056	Year data H00 to H99	Month data H01 to H12	Available	Available
DT90057	—	Day-of-the-week data H00 to H06	Available	Available

12.3.2 Setting of Clock/Calendar Function

Notes

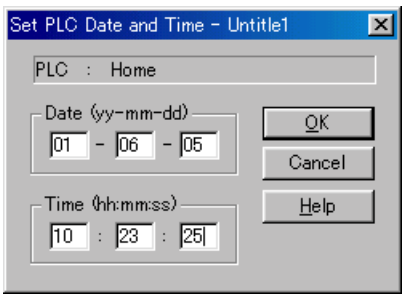
- **The clock/calendar values are backed up using a battery. Therefore, they cannot be used unless a battery has been installed in the FPΣ.**
- **There are no default clock/calendar settings, so the programming tool or another means must be used to specify these values.**

There are two ways to set the clock/calendar function:

Using the programming software

Procedure for FPWIN GR:

1. **Press <CTRL>+<F2> to switch to the [Online] screen**
2. **Tool –> Set PLC Date and Time**

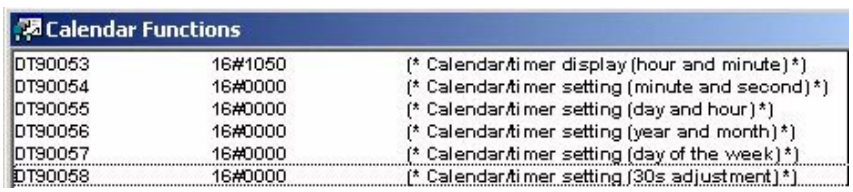


3. **Enter the date and time**
4. **OK**

Procedure for FPWIN Pro:

1. **Online –> Online Mode**
2. **Monitor –> Display Special Registers –> Calendar Functions**
3. **Enter the desired date and time values**

   Confirm each value with <Enter>.


Calendar Functions
DT90053 16#1050 (* Calendar/timer display (hour and minute) *)
DT90054 16#0000 (* Calendar/timer setting (minute and second) *)
DT90055 16#0000 (* Calendar/timer setting (day and hour) *)
DT90056 16#0000 (* Calendar/timer setting (year and month) *)
DT90057 16#0000 (* Calendar/timer setting (day of the week) *)
DT90058 16#0000 (* Calendar/timer setting (30s adjustment) *)

Using a program

1. The date/time values are written to special data registers DT90054 to DT90057, which are allocated as the clock/calendar setting area.
2. A value of H8000 is written to DT90058.

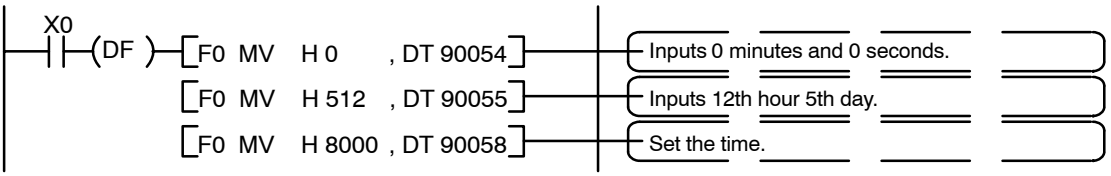
Note

The values can be set using the rising edge signal “P” (FPWIN Pro)/the differential instruction “DF” (FPWIN GR), or by changing H8000 to H0000.

Example:

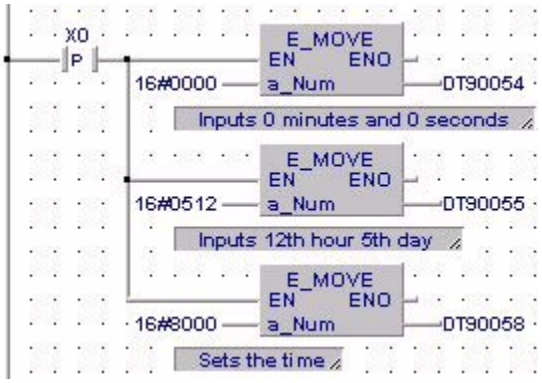
Set the time to 12:00:00 on the 5th day when X0 turns on.

FPWIN GR:


X0
DF
F0 MV H 0 , DT 90054
F0 MV H 512 , DT 90055
F0 MV H 8000 , DT 90058
Inputs 0 minutes and 0 seconds.
Inputs 12th hour 5th day.
Set the time.

FPWIN Pro:

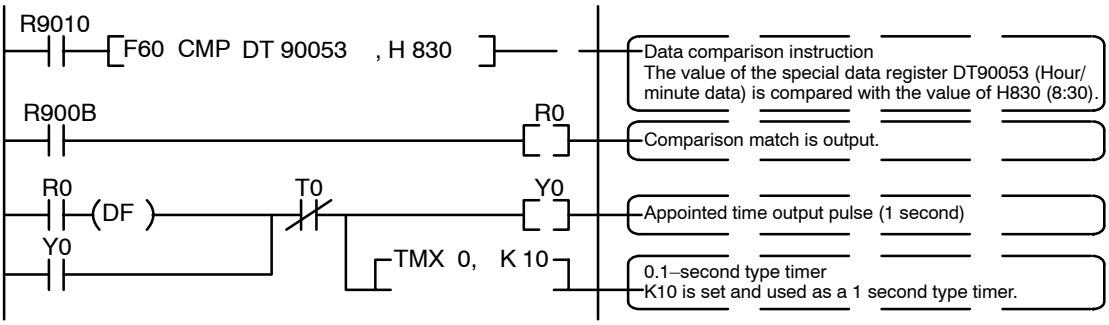
LD Body



12.3.3 Sample Program for Fixed Schedule and Automatic Start

In this example, the clock/calendar function is used to output the Y0 signal for one second at 8:30 a.m. every day. Here, the hour/minute data stored in the special data register DT90053 is used to output the signal at the appointed time.

FPWIN GR:


R9010
F60 CMP DT 90053 , H 830
Data comparison instruction
The value of the special data register DT90053 (Hour/ minute data) is compared with the value of H830 (8:30).
R900B
R0
Comparison match is output.
R0
(DF)
T0
Y0
Appointed time output pulse (1 second)
Y0
TMX 0, K 10
0.1–second type timer
K10 is set and used as a 1 second type timer.

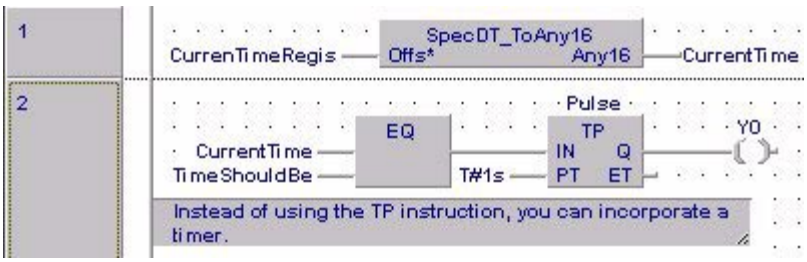
The hour data is stored in the upper 8 bits of DT90053 and the minute data in the lower 8 bits, in the BCD format. This hour and minute data is compared with the appointed time (BCD), and the R900B (=flag) special internal relay is used to detect whether or not it matches the appointed time.

FPWIN Pro:

POU Header

	Class	Identifier	Type	Initial
0	VAR	CurrentTime	WORD	0
1	VAR	TimeShouldBe	WORD	16#830
2	VAR	Pulse	TP	
3	VAR_CONSTANT	CurrenTimeRegis	INT	53

LD Body



Chapter 13

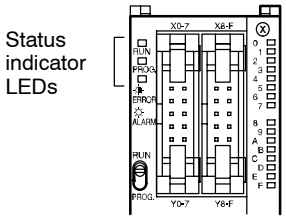
Self–Diagnostic and Troubleshooting

13.1 Self–Diagnostic Function

The control unit has a self-diagnostic function which identifies errors and stops operation if necessary.

13.1.1 LED Display for Status Condition

When an error occurs, the status of the status indicator LEDs on the control unit changes, as shown in the table below.



Status indicator LEDs on control unit

	LED status			Description	Operation status
	RUN	**PROG.**	**ERROR/ ALARM**		
Normal condition	On	Off	Off	Normal operation	Continue
	Off	On	Off	PROG mode	Stop
	Flashes	Flashes	Off	Forcing on/off in Run mode	Continue
Abnormal condition	Off	Off	Flashes	A self–diagnostic error occurred	Continue
	Off	On	Flashes	A self–diagnostic error occurred	Stop
	Varies	Varies	On	System watchdog timer has been activated	Stop

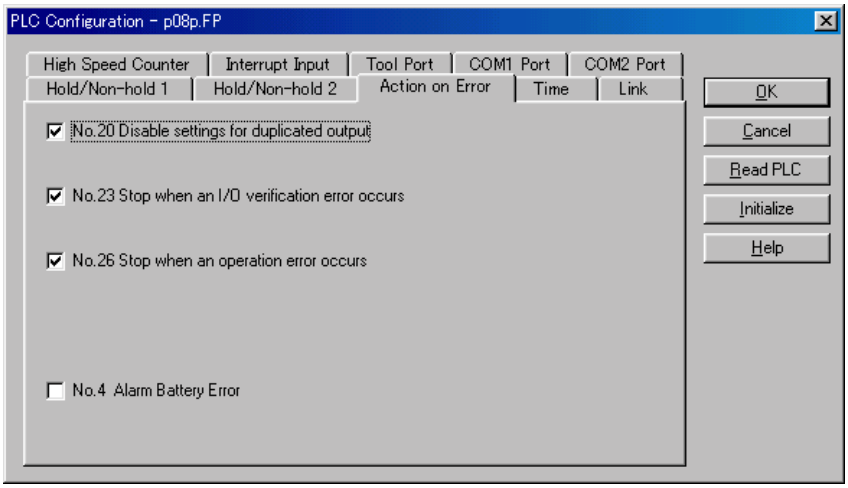
13.1.2 Operation on Error

Normally, when an error occurs, operation stops. The user may select whether operation is to be continued or stopped when certain errors occur by setting the system registers.

Procedure for FPWIN GR:

1. **Option –> PLC Configuration**

2. Select “Act on Error” tab



Procedure for FPWIN Pro:

1. Double–click “PLC” in the project navigator

2. Double–click “System Register”

3. Double–click “Act on Error”

Specify for the following errors whether operation shall be stopped or continued: I/O verification error, operation error, battery error.

No	Item Name	Data	Range	Additional Information
20	Duplicate output	Enable	Fixed	Specifies the operation when a duplicate use of output is progra
21	Output unit fuse blow	-	Unused	
22	Advanced unit error	-	Unused	
23	I/O verification error	Stop	Stop Continue	Specifies the operation when an I/O verify error happens.
24	Watchdog timer time out	-	Unused	
26	Operation error	Stop	Stop Continue	Specifies the operation when an operation error is detected.
27	Remote I/O slave link e	-	Unused	
28	I/O error in the remote	-	Unused	
4	Battery error indication	Disat	Enable Disable	Working without back-up battery The error LED switch on, if functi

Example 1: Allowing duplicated output

Turn off the check box for no. 20. When operation is resumed, it will not be handled as an error.

Example 2: Continuing operation even though a calculation error has occurred

Turn off the check box for no. 26. Operation will be continued, but will be handled as an error.

13.2 Troubleshooting

In the event of an error, follow the steps in the procedures below.

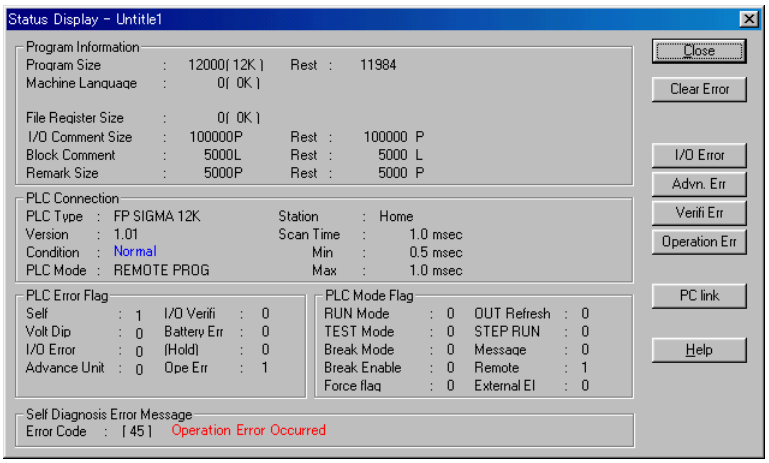
13.2.1 ERROR/ALARM LED is Flashing

Condition: The self-diagnostic error occurs.

Check the error code using the programming tool.

Procedure for FPWIN GR:

With FPWIN GR ver. 2, if a PLC error occurs during programming or debugging, the following status display dialog box is displayed automatically. Check the contents of the self–diagnosed error.

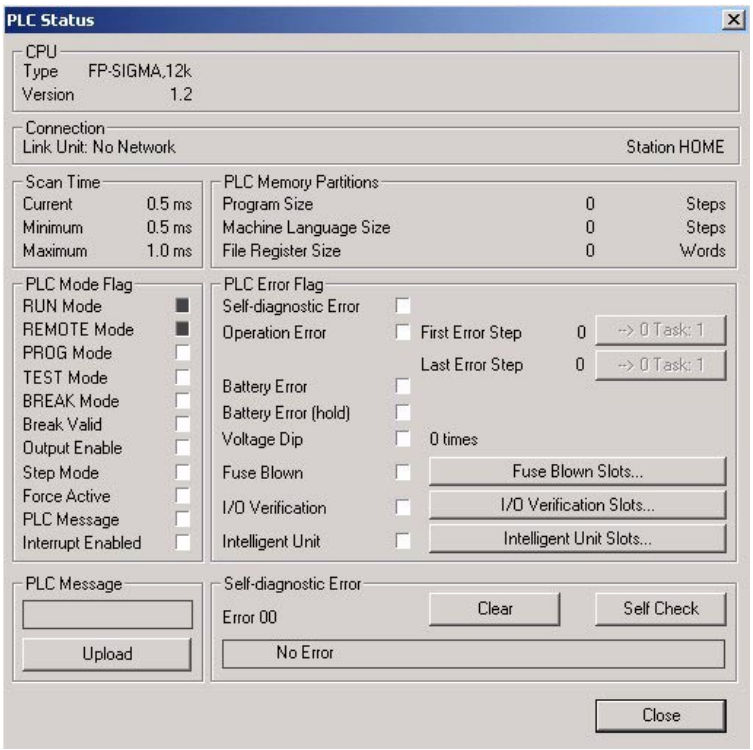

Status Display - Untitle1
Program Information
Program Size : 12000(12K) Rest : 11984
Machine Language : 0(0K)
File Register Size : 0(0K)
I/O Comment Size : 100000P Rest : 100000 P
Block Comment : 5000L Rest : 5000 L
Remark Size : 5000P Rest : 5000 P
PLC Connection
PLC Type : FP SIGMA 12K
Version : 1.01
Condition : Normal
PLC Mode : REMOTE PROG
Station : Home
Scan Time : 1.0 msec
Min : 0.5 msec
Max : 1.0 msec
PLC Error Flag
Self : 1
Volt Dip : 0
I/O Error : 0
Advance Unit : 0
I/O Verifi : 0
Battery Err : 0
(Hold) : 0
Ope Err : 1
PLC Mode Flag
RUN Mode : 0
TEST Mode : 0
Break Mode : 0
Break Enable : 0
Force flag : 0
OUT Refresh : 0
STEP RUN : 0
Message : 0
Remote : 1
External EI : 0
Self Diagnosis Error Message
Error Code : [45] Operation Error Occurred
Close
Clear Error
I/O Error
Advn. Err
Verifi Err
Operation Err
PC link
Help

If the error is an operation error, the error address can be confirmed in this dialog box.
Click on Clear Error to clear the error.

To display the status display dialog box, select **Online –> Status Display**.

Procedure for FPWIN Pro:

In online mode, select **Monitor –> PLC Status.**



Error code is 1 to 9

Condition: There is a syntax error in the program.

Procedure 1:

Change to PROG mode and clear the error.

Procedure 2:

Execute a total–check function to determine the location of the syntax error. Refer to your software manual for details about the total–check method.

Error code is 20 or higher

Condition: A self-diagnostic error other than a syntax error has occurred.

Use the programming tool in PROG mode to clear the error.

Procedure for FPWIN GR:

Click on the “Clear Error” button in the “Status display dialog box”. Error code 43 and higher can be cleared.

In PROG mode, the power supply can be turned off and then on again to clear the error, but all of the contents of the operation memory except hold type data are cleared.

An error can also be cleared by executing the self-diagnostic error set instruction **F148 (ERR)**.

Procedure for FPWIN Pro:

Select **Monitor –> PLC Status**, select Clear.

In PROG mode, the power supply can be turned off and then on again to clear the error, but all of the contents of the operation memory except hold type data are cleared.

An error can also be cleared by executing the self–diagnostic error set instruction **F148 (ERR)**.

Notes

- **If the mode selector switch has been set to "RUN", the error is cleared and at the same time operation is enabled. However, if the problem that caused the error has not been eliminated, it may look as though the error has not been cleared.**
- **When an operation error (error code 45) occurs, the address at which the error occurred is stored in special data registers DT90017 and DT90018. If this happens, monitor the address at which the error occurred before cancelling the error.**

13.2.2 ERROR/ALARM LED is ON

Condition: The system watchdog timer has been activated and the operation of the PLC has been stopped.

Procedure 1

Set the mode selector of the PLC from RUN to PROG mode and turn the power off and then on.

– If the ERROR/ALARM LED is turned on again, there is probably an abnormality in the FPΣ control unit. Please contact your dealer.

– If the ERROR/ALARM LED is blinking, see page 13-4.

Procedure 2

Set the mode selector from PROG to RUN mode.

– If the ERROR/ALARM LED is turned on, the program execution time is too long. Check:

- if instructions such as **JP** or **LOOP** are programmed in such a way that a scan can never finish.
- that interrupt instructions are executed in succession.

13.2.3 All LEDs are OFF

Procedure 1

Check the power supply wiring.

Procedure 2

Check if the power supplied to the FPΣ control unit is in the range of the rating.

– Be sure to check the fluctuation in the power supply.

Procedure 3

Disconnect the power supply wiring to the other devices if the power supplied to the FPΣ control unit is shared with them.

– If the LEDs on the control unit turn on at this moment, increase the capacity of the power supply or prepare another power supply for other devices.

13.2.4 Diagnosing Output Malfunction

Proceed from the check of the output side to the check of the input side.

Check of output condition 1: Output indicator LEDs are ON

Procedure 1

Check the wiring of the loads.

Procedure 2

Check if the power is properly supplied to the loads.

– If the power is properly supplied to the load, there is probably an abnormality in the load. Check the load again.

– If the power is not supplied to the load, there is probably an abnormality in the output section. Please contact your dealer.

Check of output condition 2: Output indicator LEDs are OFF

Procedure 1

Monitor the output condition using a programming tool.

– If the output monitored is turned on, there is probably a duplicated output error.

Procedure 2

Forcing ON the output using the programming tool.

– If the output indicator LED is turned ON, go to input condition check.

– If the output indicator LED remains OFF, there is probably an abnormality in the output unit. Please contact your dealer.

Check of input condition 3: Input indicator LEDs are OFF

Procedure 1

Check the wiring of the input devices.

Procedure 2

Check that the power is properly supplied to the input terminals.

– If the power is properly supplied to the input terminal, there is probably an abnormality in the input unit. Please contact your dealer.

– If the power is not supplied to the input terminal, there is probably an abnormality in the input device or input power supply. Check the input device and input power supply.

Check of input condition 4: Input indicator LEDs are ON

Procedure

Monitor the input condition using a programming tool.

– If the input monitored is OFF, there is probably an abnormality with the input unit. Please contact your dealer.

– If the input monitored is ON, check the leakage current at the input devices (e.g. two-wire type sensor) and check the program again, referring to the following:
Check for the duplicated use of outputs and for outputs using the high–level instruction.
Check the program flow when a control instruction such as **MC** or **JP** is used.

13.2.5 A Protect Error Message Appears

When a Password Function is Used

Procedure for FPWIN GR:

1. **Tool –> Set PLC Password**



2. **Select "Access"**
3. **Enter a password**
4. **Choose Settings**

Procedure for FPWIN Pro:

1. **Online –> PLC Password**



2. **Enter a password**
3. **Choose OK**

13.2.6 PROG Mode does not Change to RUN

Condition: A syntax error or a self–diagnosed error that caused operation to stop has occurred.

Procedure 1

Check to see if the ERROR/ALARM LED is flashing.
In this case, see page 13-4.

Procedure 2

Execute a total–check function to determine the location of the syntax error. Refer to your software manual for details about the total–check method.

13.2.7 A Transmission Error has Occurred

Procedure 1

Check to make sure the transmission cables have been securely connected between the two (+) terminals and the two (–) terminals of the units, and that the final unit has been connected correctly.

Procedure 2

Check to see if the transmission cables are within the specifications range (see page 8-11).

Make sure all of the cables in the link are of the same type.

Do not designate any unit other than those at both ends of the network as a terminal station.

Procedure 3

Check that link areas do not overlap.

Appendix A

Specifications, Dimensions

A.1 General Specifications

Item		Description	
Rated operating voltage		24 V DC	
Operating voltage range		21.6 to 26.4 V DC	
Allowed momentary power off time	**C32, C28**	4 ms at 21.6 V, 7 ms at 24 V, 10 ms at 26.4 V	
	C24	3 ms at 21.6 V, 5 ms at 24 V, 8 ms at 26.4 V	
Ambient temperature		0 to +55 °C/32 to +131 °F	
Storage temperature		–20 to +70 °C/–4 to +158 °F	
Ambient humidity		30 to 85 % RH (non-condensing)	
Storage humidity		30 to 85 % RH (non-condensing)	
Breakdown voltage	**C32, C28**	Between input/output terminals and power supply terminal/function earth	500 VAC for 1 minute
		Between input terminal and output terminal	
	C24	Between input terminals (X0 to X7)/input terminals (X8 to XF) and power supply terminal/function earth	500 VAC for 1 minute
		Between output terminals and power supply terminal/function earth	1500 VAC for 1 minute
		Between input terminals (X0 to X7) and input terminals (X8 to XF)	500 VAC for 1 minute
		Between input terminals (X0 to X7)/input terminals (X8 to XF) and output terminals	1500 VAC for 1 minute
Insulation resistance	**C32, C28**	Between input/output terminals and power supply terminal/function earth	Min. 100Ω (measured with a 500 V DC megger)
		Between input terminal and output terminal	
	C24	Between input terminals (X0 to X7)/input terminals (X8 to XF) and power supply terminal/function earth	
		Between output terminals and power supply terminal/function earth	
		Between input terminals (X0 to X7) and input terminals (X8 to XF)	
		Between input terminals (X0 to X7)/input terminals (X8 to XF) and output terminals	
Vibration resistance		10 to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm/0.030 in., 10 min on 3 axes	
Shock resistance		Shock of 98 m/s^2 or more, 4 times on 3 axes	
Noise immunity		1,000 Vp-p with pulse widths 50 ns and 1 μs (based on in-house measurements)	
Operating condition		Free from corrosive gases and excessive dust	

Weight

Unit type	Part No.	Weight
FPΣ control unit	FPG–C32/C28	Approx. 120 g/4.24 oz
	FPG–C24	Approx. 140 g/4.94 oz
FPΣ expansion unit	FPG–XY64D2T	Approx. 100 g/3.53 oz
	FPG–PP11/PP12/PP21/PP22	Approx. 105 g/3.70 oz
	FPG–EM1	Approx. 80 g/2.82 oz

Unit type	Part No.	Weight
FP0 expansion unit	FP0–E8X	Approx. 65 g/2.29 oz
	FP0–E8R/E8YR	Approx. 90 g/3.17 oz
	FP0–E8YT/E8YP	Approx. 65 g/2.29 oz
	FP0–E16R	Approx. 105 g/3.70 oz
	FP0–E16T/E16P/E16X/E16YT/E16YP	Approx. 70 g/2.47 oz
	FP0–E32T/E32P	Approx. 85 g/3.00 oz
	FP0–AD21/AD8	Approx. 90 g/3.17 oz
	FP0–TC4	Approx. 85 g/3.00 oz
	FP0–TC8	Approx. 95 g/3.35 oz

Current consumption

Unit type		Control unit (The current consumed by the control unit power supply connector. If expansion units or intelligent units are added, the current is increased by the value indicated below.)	Expansion unit (The current consumed by the expansion unit power supply connector. If a unit is not listed below, it means that it has no power supply connector.)	Input circuit (The current consumed by the input circuits of the various units. The value indicates the current that flows into the input circuit. "n" indicates the number of points that are on.)	Output circuit (The current consumed by the output circuits of the various units. The value indicates the current used to drive the output circuits. "n" indicates the number of points that are on. The value does not include the load current value.)
FPΣ control unit	FPG–C32C28	90 mA or less	—	77.2 mA or less	70 mA or less
	FPG–C24	160 mA or less	—	77.2 mA or less	—
FPΣ intelligent unit	FPG–PP11/PP12	150 mA or less	20 mA or less	—	—
	FPG–PP21/PP22	220 mA or less	35 mA or less	—	—
	FPG–EM1	35 mA or less	—	—	—
FPΣ expansion unit	FPG–XY64D2T	35 mA or less	—	3.5 x n mA or less	15 mA or less
FP0 expansion unit	FP0–E8X	10 mA or less	—	4.3 x n mA or less	—
	FP0–E8R	15 mA or less	50 mA or less	4.3 x n mA or less	—
	FP0–E8YR	10 mA or less	100 mA or less	—	—
	FP0–E8YT	15 mA or less	—	—	3 x n mA or less
	FP0–E16X	20 mA or less	—	4.3 x n mA or less	—
	FP0–E16R	20 mA or less	100 mA or less	4.3 x n mA or less	—
	FP0–E16T	25 mA or less	—	4.3 x n mA or less	3 x n mA or less
	FP0–E16YT	25 mA or less	—	—	3 x n mA or less
	FP0–E32T	40 mA or less	—	4.3 x n mA or less	3 x n mA or less
FP0 intelligent unit	FP0–A21	20 mA or less	100 mA or less	—	—
	FP0–A80	20 mA or less	60 mA or less	—	—
	FP0–TC4/TC8	25 mA or less	—	—	—
	FP0–IOL	30 mA or less	40 mA or less	—	—
Communication cassette	FPG–COM1 FPG–COM2	20 mA or less	—	—	—
	FPG–COM3	25 mA or less	—	—	—

A.2 Performance Specifications

Item			Descriptions			
			FPG–C32T/ C32TTM	FPG–C32T2/ C32T2TM	FPG–C24R2/ C24R2TM	FPG–C28P2
Number of controllable I/O points		Control unit	32 points (DC input: 16, NPN output: 16)	32 points (DC input: 16, NPN output: 16)	24 points (DC input: 16, relay output: 8)	28 points (DC input: 16, PNP output: 12)
		With FP0 expansion units	Max. 128 points (up to 3 units)	Max. 128 points (up to 3 units)	Max. 120 points (up to 3 units) When using transistor output type expansion units	Max. 124 points (up to 3 units)
		With FPΣ expansion units	Not possible	Max. 288 points (up to 4 units)	Max. 280 points (up to 4 units) When using transistor output type expansion units	Max. 284 points (up to 4 units) When using NPN output type expansion units
		With FP0 and FPΣ expansion units	—	Max. 384 points (up to 3 FP0 units and 4 FPΣ units)	Max. 376 points (up to 3 FP0 units and 4 FPΣ units) When using transistor output type expansion units	Max. 380 points (up to 3 FP0 units and 4 FPΣ units) When using NPN output type expansion units
Programming method/Control method			Relay symbol/Cyclic operation			
Program memory			Built–in flash ROM (without backup battery) (Exclusive FPΣ instructions allow writing and reading data.)			
Program capacity			12,000 steps			
Number of instructions		Basic	85			
		High–level	220			
Operation speed			0.4 μs/step (for basic instruction)			
Operation memory points	Relay	External input relay (X)	512 points (see note 7)	1,184 points (see note 7)		
		External output relay (Y)	512 points (see note 7)	1,184 points (see note 7)		
		Internal relay (R)	1,568 points (R0 to R97F) (see note 1)			
		Timer/Counter (T/C)	1,024 points (see note 1 and 2) (for initial setting, timer: 1,008 points (T0 to T1007), counter: 16 points (C1008 to C1023) Timer: Counts each unit up to 32767 times (units: 1 ms, 10 ms, 100 ms, or 1 s). Counter: Counts 1 to 32767.			
		Link relays (L)	1,024 points (see note 1)			
	Memory area	Data register (DT)	32,765 words (DT0 to DT32764) (see note 1)			
		Link data register (LD)	128 words (see note 1)			
		Index register (I)	14 words (I0 to ID)			
Differential points			Unlimited			
Master control relay points (MCR)			256			
Number of labels (JP and LOOP)			256			
Number of step ladders			1,000 stages			

Item	Descriptions
Number of subroutines	100 subroutines
Pulse catch input	8 points (X0 to X7)
Number of interrupt programs	9 programs (8 external input points “X0 to X7”, 1 periodical interrupt point “0.5 ms to 30s”)
Self–diagnosis function	E. g. watchdog timer, program syntax check
Clock/calendar function	Available (year, month, day, hour, minute, second and day of week); however, this function can only be used when a battery has been installed (see note 3).
Potentiometer (Volume) input	2 points, resolution: 10 bits (K0 to K1000) (for FPG–C32T, C32T2, C24R2 and C28P2 only)
Thermistor unit	2 points, resolution: 10 bits (K0 to K1000) (for FPG–C32TTM, C32T2TM and C24R2TM only)
Battery life	220 days or more* (actual usage value: approx. 840 days (25°C). Suggested replacement interval: 1 year. *Value applies when no power is supplied at all.
Comment storage	All kinds of comments, including I/O comments, remarks, and block comments, can be stored (without backup battery).
Link function	Computer link (1:1, 1:N) (see note 4) General–purpose communication (1:1, 1:N) (see note 4) (see note 5) PLC link (see note 6)
Other functions	Program edition during RUN, constant scan, forced on/off, password, floating–point operation, and PID processing

Notes

1) **If no battery is used, only the fixed area is backed up (counters 16 points: C1008 to C1023, internal relays 128 points: R900 to R97F, data registers 55 words: DT32710 to DT32764). When the optional battery is used, data can be backed up. Areas to be held and not held can be specified using the system registers.**
2) **The number of points can be increased by using an auxiliary timer.**
3) **Precision of calendar timer:**
   – At 0°C/32°F, less than 119 seconds error per month.
   – At 25°C/77°F, less than 51 seconds error per month.
   – At 55°C/131°F, less than 148 seconds error per month.
4) **An optional communication cassette (RS232C type) is required in order to use 1 : 1 communication. (Re–send processing is recommended.)**
5) **An optional communication cassette (RS485 type) is required in order to use 1 : N communication. (Re–send processing is recommended.)**
6) **An optional communication cassette (RS485 type) is required.**
7) **The number of points actually available for use is determined by the hardware configuration.**

High–speed counter, pulse output and PWM output specifications

Item		Descriptions	
High–speed counter	**Input point number**	Single–phase: max. 4 channels	Two–phase: max. 2 channels
	Maximum counting speed	Single–phase: for 1 channel: max. 50 kHz (x 1) for 2 channels: max. 30 kHz (x 2) for 3 or 4 channels: max. 20 kHz (x 3 or 4)	Two–phase: for 1 channel: max. 20 kHz (x 1) for 2 channels: max. 15 kHz (x 2)
	Input mode	Single–phase: incremental decremental	Two–phase: two–phase, incremental/decremental, incremental/decremental control
	Input contact used (see note1)	Single–phase: X0: count input (CH0) X1: count input (CH1) X2: reset input (CH0, CH1) X3: count input (CH2) X4: count input (CH3) X5: reset input (CH2, CH3)	Two–phase: X0, X1: count input (CH0) X2: reset input (CH0) X3, X4: count input (CH2) X5: reset input (CH2)
Pulse output	**Output point number**	Two independent points (simultaneous output possible)	
	Output mode	CW and CCW mode, pulse and direction mode	
	Maximum output frequency	1 channel: max. 100 kHz (x 1) 2 channels: max. 60 kHz (x 2)	(linear interpolation function: max. 100 kHz arc interpolation function: max. 20 kHz)
	High–speed counter used (see note 2)	Two–phase CH0 or CH2	
	Input/Output contact used (see note 1)	X2 or X5: home input Y0 or Y3: CW output or pulse output Y1 or Y4: CCW output or direction output Y2 or Y5: deviation counter reset output	
PWM output	**Output point number**	Two points (Y0, Y3)	
	Output frequency	1.5 to 12.5k Hz (at resolution of 1000), 15.6k to 41.7k Hz (at resolution of 100)	
	Output duty	0.0 to 99.9% (at resolution of 1000), 1 to 99% (at resolution of 100)	
	High–speed counter used (see note 2)	Two–phase CH0 or CH2	
	Output contact used (see note 1)	Y0 or Y3	

Notes

1) The contacts noted above cannot be allocated for more than one function. Also, contacts that are not assigned to the various functions can be used as general inputs/outputs. Inputs X0 to X5 are pulse catch inputs, and can also be used for interrupt inputs.

2) If using pulse output or PWM output, one channel of the two–phase high–speed counter is used for each output point, in each case. If only one pulse output point is being used, either one point of the two–phase high–speed counter or three points of the single–phase high–speed counter may be used.

Serial communication specifications (1:1 communication) (see note 1)

Item	Description
Communication method	Half duplex transmission
Synchronous method	Start stop synchronous system
Transmission line	RS232C
Transmission distance	15 m/49.21 ft.
Transmission speed (Baud rate)	2,400 bits/s to 115.2k bits/s (see note 2)
Transmission code	ASCII
Transmission format	Stop bit: 1 bit/2 bits, parity: none/even/odd, data length: 7 bits/8 bits (see note 2) Start codes: No STX/STX; End codes: CR/CR+LF/None/ETX
Interface	Conforming to RS232C (connected via the terminal block)

Notes

1) **In order to use the serial communication function (1:1 communication), a RS232C type communication cassette is required.**
2) **The transmission speed (baud rate) and transmission format are specified using the system registers.**

Serial communication specifications (1:N communication) (see note 1)

Item	Description
Communication method	Two–wire, half duplex transmission
Synchronous method	Start stop synchronous system
Transmission line	Twisted–pair cable or VCTF
Transmission distance (Total distance)	Maximum 1,200 m/3,937 ft. (see notes 4 and 5)
Transmission speed (Baud rate)	2,400 bits/s to 115.2k bits/s 19,200 bits/s when a C–NET adapter is connected (see notes 2, 4 and 5)
Transmission code	ASCII
Transmission format	Stop bit: 1 bit/2 bits, parity: none/even/odd, data length: 7 bits/8 bits (see notes 2) Start codes: No STX/STX; End codes: CR/CR+LF/None/ETX
Number of units (stations)	Maximum 99 units (stations) 32 units (stations) max. when a C–NET adapter is connected (see notes 3, 4 and 5)
Interface	Conforming to RS485 (connected via the terminal block)

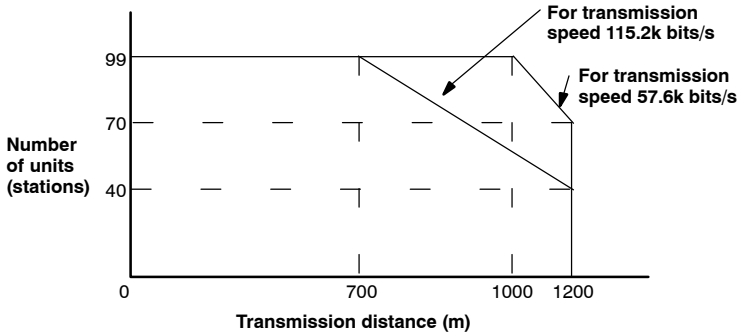
Notes

1) **In order to use the serial communication function (1:N communication), a RS485 type communication cassette is required.**
2) **The transmission speed (baud rate) and transmission format are specified using the system registers.**

3) Unit (station) numbers are specified using the system registers. Up to 31 units (stations) can be set, using the switches on the control unit.

4) When connecting a commercially available device that has an RS485 interface, please confirm operation using the actual device. In some cases, the number of units (stations), transmission distance, and transmission speed (baud rate) vary depending on the connected device.

5) The values for the transmission distance, transmission speed (baud rate), and number of units (stations) should be within the values noted in the graph below.



For a transmission speed of 2,400 bits/s to 38.4k bits/s, you can set up a maximum of 99 units (stations) and a maximum transmission distance of 1,200 m.

PLC link function specification (see note 1)

Item	Description
Communication method	Token bus
Transmission method	Floating master method
Transmission line	Twisted–pair cable or VCTF
Transmission distance (Total distance)	1,200 m/3,937 ft.
Transmission speed (Baud rate)	115.2k bits/s
Number of units (stations)	Maximum 16 units (see note 2)
PLC link capacity	Link relay: 1,024 points, link register: 128 words
Interface	Conforming to RS485 (connected via the terminal block)

Notes

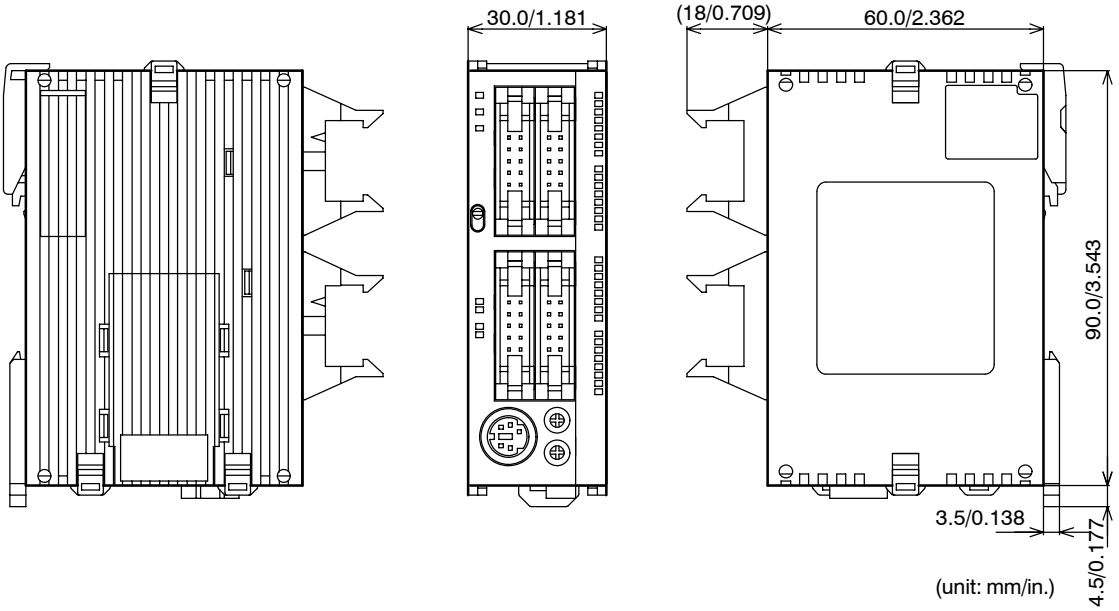
1) A RS485 type communication cassette is required in order to use the PLC link function.

2) Unit (station) numbers are specified using the switches on the control unit or the system registers.

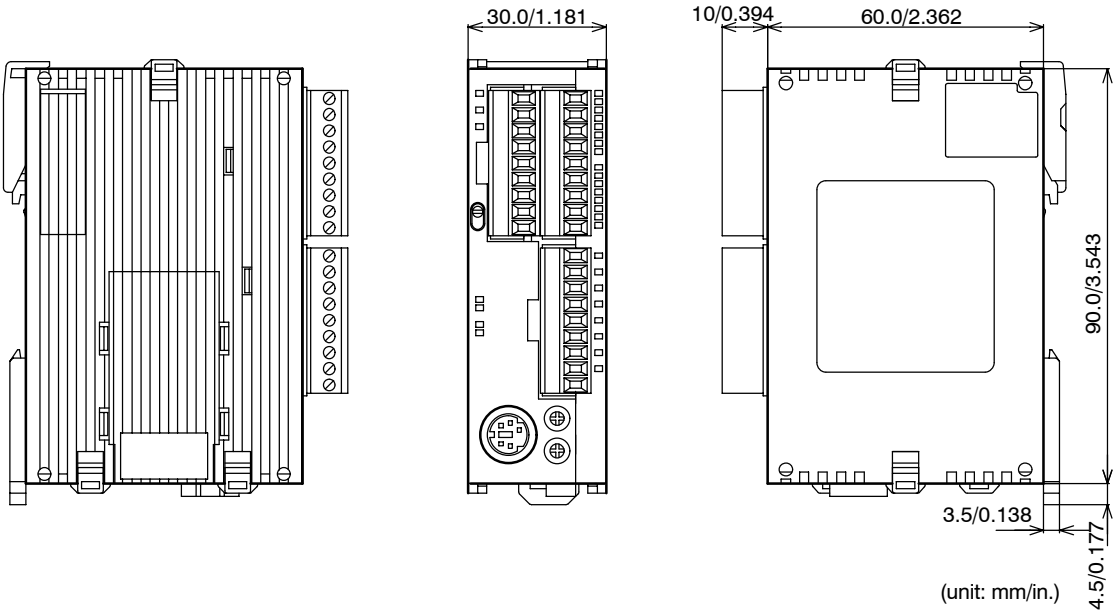
A.3 Dimensions

A.3.1 Control Unit

FPG–C32T, FPG–C32T2, FPG–C28P2

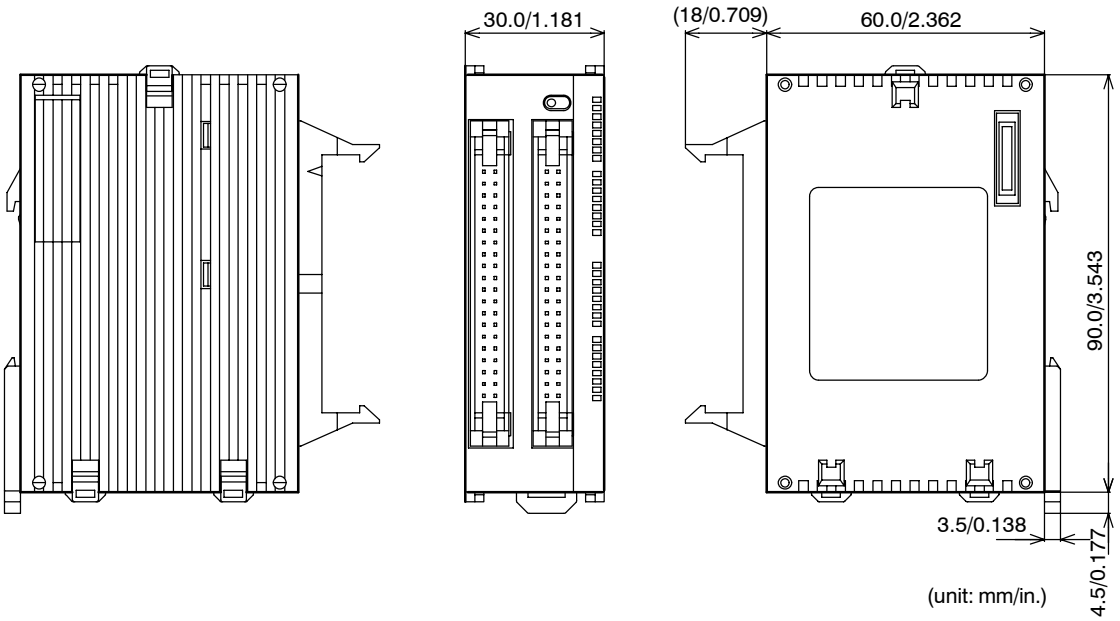


FPG–C24R2



A.3.2 Expansion Unit

FPG–XY64D2T



Appendix B

Programming Information

B.1 General Note

The explanations in this appendix often utilize FPWIN GR conventions. When using FPWIN Pro for programming, please note these slight differences:

- Hexadecimal values are represented by the prefix 16# and not H.
- Decimal values do not require a K prefix.
- Inputs and outputs are labeled slightly differently, e.g. S vs. s, etc.

For IEC instructions, please see the FPWIN Pro online help or the FPΣ programming manual.

B.2 Relays, Memory Areas and Constants

Item		Number of points	Memory area available for use		Function
			Matsushita	IEC	
Relay	**External input relay (see note 1) FPG–C32T/C32TTM**	512	**X**0–**X**31F	%**IX**0.0– %**IX**31.15	Turns on or off based on external input.
	External input relay (see note 1) FPG–C32T2/C32T2TM FPG–C24R2/C24R2TM FPG–C28P2	1184	**X**0–**X**73F	%**IX**0.0– %**IX**73.15	
	External output relay (see note 1) FPG–C32T/C32TTM	512	**Y**0–**Y**31F	%**QX**0.0– %**QX**31.15	Externally outputs on or off state.
	External output relay (see note 1) FPG–C32T2/C32T2TM FPG–C24R2/C24R2TM FPG–C28P2	1184	**Y**0–**Y**73F	%**QX**0.0– %**QX**73.15	
	Internal relay (see note 2)	1568	**R**0–**R**97F	%**MX0**.0– %**MX0**.97.15	Turns on or off only within a program.
	Link relay (see note 2)	1024	**L**0–**L**63F	%**MX7**.0.0– %**MX7**.63.15	Shared relay used for PLC link.
	Timer (see notes 2 and 3)	1024	**T**0–**T**1007/ **C**1008–**C**1023	%**MX1**.0– %**MX1**.1007/ %**MX2**.1008– %**MX2**.1023	Goes on when the timer reaches the specified time. Corresponds to the timer number.
	Counter (see notes 2 and 3)	1024	**C**1008–**C**1023/ **T**0–**T**1007	%**MX2**.1008– %**MX2**.1023/ %**MX1**.0– %**MX1**.1007	Goes on when the timer increments. Corresponds to the timer number.
	Special internal relay	176	**R**9000–**R**910F	%**MX0**.900.0– %**MX0**.910.15	Turns on or off based on specific conditions. Used as a flag.
Memory area (words)	**External input relay (see note 1) FPG–C32T/C32TTM**	32 words	**WX**0–**WX**31	%**IW**0– %**IW**31	Code for specifying 16 external input points as one word (16 bits) of data.
	External input relay (see note 1) FPG–C32T2/C32T2TM FPG–C24R2/C24R2TM FPG–C28P2	74 words	**WX**0–**WX**73	%**IW**0– %**IW**73	
	External output relay (see note 1) FPG–C32T/C32TTM	32 words	**WY**0–**WY**31	%**QW**0– %**QW**31	Code for specifying 16 external output points as one word (16 bits) of data.
	External output relay (see note 1) FPG–C32T2/C32T2TM FPG–C24R2/C24R2TM FPG–C28P2	74 words	**WY**0–**WY**73	%**QW**0– %**QW**73	
	Internal relay (see note 2)	98 words	**WR**0–**WR**97	%**MW0**.0– %**MW0**.97	Code for specifying 16 internal relay points as one word (16 bits) of data.
	Link relay	64 words	**WL**0–**WL**63	%**MW7**.0– %**MW7**.63	Code for specifying 16 link relay points as one word (16 bits) of data.

Item		Number of points	Memory area available for use		Function
			Matsushita	IEC	
Memory area (words)	**Data register (see note 2)**	32765 words	**DT**0–**DT**32764	%**MW5**.0–%**MW5**.32764	Data memory used in a program. Data is handled in 16-bit units (one word).
	Link data register (see note 2)	128 words	**LD**0–**LD**127	%**MW8**.0–%**MW8**.127	A shared data memory which is used within the PLC link. Data is handled in 16-bit units (one word).
	Timer/counter set value area (see note 2)	1024 words	**SV**0–**SV**1023	%**MW3**.0–%**MW3**.1023	Data memory for storing a target value of a timer and an initial value of a counter. Stores by timer/counter number.
	Timer/counter elapsed value area (see note 2)	1024 words	**EV**0–**EV**1023	%**MW4**.0–%**MW4**.1023	Data memory for storing the elapsed value during operation of a timer/counter. Stores by timer/counter number.
	Special data register	260 words	**DT**90000–**DT**90259	%**MW5**.90000–%**MW5**.90259	Data memory for storing specific data. Various settings and error codes are stored.
	Index register	14 words	**I**0–**I**D	%**MW6**.0–%**MW6**.14	Can be used as an address of memory area and constants modifier.
Memory area (double word) (see note 4)	**External input relay (see note 1) FPG–C32T/C32TTM**	16 double words	**DWX**0–**DWX**30	%**ID**0–%**ID**30	Code for specifying 32 external input points as a double word (32 bits) of data.
	External input relay (see note 1) FPG–C32T2/C32T2TM FPG–C24R2/C24R2TM FPG–C28P2	37 double words	**DWX**0–**DWX**73	%**ID**0–%**ID**73	Code for specifying 32 external input points as a double word (32 bits) of data.
	External output relay (see note 1) FPG–C32T/C32TTM	16 double words	**DWY**0–**DWY**30	%**QD**0–%**QD**30	Code for specifying 32 external output points as double word (32 bits) of data.
	External output relay (see note 1) FPG–C32T2/C32T2TM FPG–C24R2/C24R2TM FPG–C28P2	37 double words	**DWY**0–**DWY**73	%**QD**0–%**QD**73	Code for specifying 32 external output points as double word (32 bits) of data.
	Internal relay (see note 2)	49 double words	**DWR**0–**DWR**96	%**MD0**.0–%**MD0**.96	Code for specifying 32 internal relay points as double word (32 bits) of data.
	Link relay	32 double words	**DWL**0–**DWL**62	%**MD7**.0–%**MD7**.62	Code for specifying 32 link relay points as double word (32 bits) of data.

Item		Number of points	Memory area available for use		Function
			Matsushita	IEC	
Memory area (double word) (see note 4)	**Data register (see note 2)**	16382 double words	**DDT**0–**DDT**32763	%**MD5**.0–%**MD5**.32763	Data memory used in a program. Data is handled in 32-bit units (double word).
	Link data register (see note 2)	64 double words	**DLD**0–**DLD**126	%**MD8**.0–%**MD8**.126	A shared data memory which is used within the PLC link. Data is handled in 32-bit units (double word).
	Timer/counter set value area (see note 2)	512 double words	**DSV**0–**DSV**1022	%**MD3**.0–%**MD3**.1022	Data memory for storing a target value of a timer and an initial value of a counter. Stores by timer/counter number.
	Timer/counter elapsed value area (see note 2)	512 double words	**DEV**0–**DEV**1022	%**MD4**.0–%**MD4**.1022	Data memory for storing the elapsed value during operation of a timer/counter. Stores by timer/counter number.
	Special data register	130 double words	**DDT**90000–**DDT**90258	%**MD5**.90000–%**MD5**.90258	Data memory for storing specific data. Various settings and error codes are stored.
	Index register	7 double words	**DI**0–**DI**C	%**MD6**.0–%**MD6**.13	Can be used as an address of memory area and constants modifier.

Item		Range available for use	
		Matsushita	IEC
Constant	**Decimal constants (integer type)**	K–32768 to K32767 (for 16-bit operation)	–32768 to 32767 (for 16-bit operation)
		K–2147483648 to K2147483647 (for 32-bit operation)	–2147483648 to 2147483647 (for 32-bit operation)
	Hexadecimal constants	H0 to HFFFF (for 16-bit operation)	16#0 to 16#FFFF (for 16-bit operation)
		H0 to HFFFFFFFF (for 32-bit operation)	16#0 to 16#FFFFFFFF (for 32-bit operation)
	Decimal constants (monorefined real number)	F–1.175494 $\times 10^{-38}$ to F–3.402823 $\times 10^{38}$	–1.17549410E–38to –3.402823E38
		F1.175494 $\times 10^{-38}$ to F3.402823 $\times 10^{38}$	1.17549410E–38to 3.402823E38

Notes

1) The number of points noted above is the number reserved as the calculation memory. The actual number of points available for use is determined by the hardware configuration.

2) If no battery is used, only the fixed area is backed up (counters 16 points: C1008 to C1023, internal relays 128 points: R900 to R97F, data registers: DT32710 to DT32764). When the optional battery is used, data can be backed up. Areas to be held and not held can be specified using the system registers.

3) The points for the timer and counter can be changed by the setting of system register 5. The number given in the table are the numbers when system register 5 is at its default setting.

4) Double words cannot be specified with FPWIN GR.

B.3 System Registers

System registers are used to set values (parameters) which determine operation ranges and functions used. Set values based on the use and specifications of your program. There is no need to set system registers for functions which will not be used.

B.3.1 Precautions When Setting System Registers

Sytem register settings are effective from the time they are set.

However, MEWNET–W0 PLC link settings, input settings, Tool and COM port communication settings become effective when the mode is changed from PROG to RUN. With regard to the modem connection setting, when the power is turned off and on or when the mode is changed from PROG to RUN, the controller sends a command to the modem which enables it for reception.

When the initialization operation is performed, all system register values (parameters) set will be initialized.

B.3.2 Types of System Registers

Hold/non–hold type settings (system registers 5 to 8, 10, 12 and 14)

The values for the timer and counter can be specified by using system register no. 5 to specify the first number of the counter. System registers no. 6 to no. 8, no. 10, no. 12, and no. 14 are used to specify the area to be held when a battery is used.

Operation mode settings for errors (system registers 4, 20, 23 and 26)

Set the operation mode when errors such as battery error, duplicated use of output, I/O verification error and operation error occur.

Time settings (system registers 31 to 34)

Set time-out error detection time and constant scan time.

MEWNET–W0 PLC link settings (system registers 40 to 45, and 47)

These settings are for using link relays and link registers in MEWNET–W0 PLC link communication. Note that PLC link is not the default setting.

Input settings (system register 400 to 403)

When using the high–speed counter function, pulse catch function or interrupt function, set the operation mode and the input number to be used for the function.

Tool and COM port communication settings (system registers 410 to 419)

Set these registers when the Tool port, and COM1 and COM2 ports are to be used for computer link, general–purpose serial communication, PLC link, and modem communication. Note that the default setting is computer link mode.

B.3.3 Checking and Changing System Registers

Procedure for FPWIN GR:

1. **Set the control unit in the PROG mode.**
2. **Option –> PLC Configuration**
3. **When the function for which settings are to be entered is selected in the PLC Configuration dialog box, the value and setting status for the selected system register are displayed. To change the value and setting status, write in the new value and/or select the setting status.**
4. **To register these settings, choose OK**

Procedure for FPWIN Pro:

1. **Double–click "PLC" in the project navigator**
2. **Double–click "System Register"**
3. **To change a set value, write the new value as indicated in the system register table**
4. **Online –> Online mode**
5. **Online –> Download Program Code and PLC Configuration**

   This downloads the project and system registers.

   To download system registers only: **Online –> PLC Configuration**, select "System Registers", choose Download to PLC.

B.3.4 Table of System Registers

Item	No.	Name	Default value	Descriptions	
Hold/ Non–hold 1	**5**	Starting number setting for counter	1008	0 to 1024	
	6	Hold type area starting number setting for timer and counter	1008	0 to 1024	• These settings are effective if the optional backup battery is installed • If no backup battery is used, do not change the default settings. Otherwise proper functioning of hold/non–hold values cannot be guaranteed.
	7	Hold type area starting number setting for internal relays	90	0 to 98	
	8	Hold type area starting number setting for data registers	32710	0 to 32765	
	14	Hold or non–hold setting for step ladder process	Non–hold	Hold/Non–hold	
Hold/ Non–hold 2	**10**	Hold type area starting number for PLC link relays	64	0 to 64	
	12	Hold type area starting number for PLC link registers	128	0 to 128	
Action on error	**20**	Disable or enable setting for duplicated output	Yes FPWIN GR: Disabled	Fixed FPWIN GR: Disabled/Enabled	
	23	Operation setting when an I/O verification error occurs	Stop	Stop/Continuation of operation	
	26	Operation setting when an operation error occurs	Stop	Stop/Continuation of operation	
	4	Alarm Battery Error (Operating setting when battery error occurs)	Disabled	Disabled: When a battery error occurs, a self-diagnostic error is not issued and the ERROR/ALARM LED does not light. Enabled: When a battery error occurs, a self-diagnostic error is issued and the ERROR/ALARM LED lights.	
Time setting	**31**	Wait time setting for multi-frame communication	6500.0 ms	10 to 81900 ms	
	34	Constant value settings for scan time	0.0 ms	0: Normal scan 0 to 350 ms: Scans once each specified time interval.	
PLC link setting	**40**	Range of link relays used for PLC link	0	0 to 64 words	
	41	Range of link data registers used for PLC link	0	0 to 128 words	
	42	Starting number for link relay transmission	0	0 to 63	
	43	Link relay transmission size	0	0 to 64 words	
	44	Starting number for link data register transmission	0	0 to 127	
	45	Link data register transmission size	0	0 to 127 words	
	47	Maximum unit number setting for MEWNET–W0 PLC link	16	1 to 16	

Item	No.	Name	Default value	Descriptions	
High–speed counter	**400**	High-speed counter operation mode settings (X0 to X2)	CH0: Do not set input X0 as high–speed counter	CH0	Do not set input X0 as high-speed counter. Two-phase input (X0, X1) Two-phase input (X0, X1), reset input (X2) Incremental input (X0) Incremental input (X0), reset input (X2) Decremental input (X0) Decremental input (X0), reset input (X2) Incremental/decremental input (X0, X1) Incremental/decremental input (X0, X1), reset input (X2) Incremental/decremental control input (X0, X1) Incremental/decremental control input (X0, X1), reset input (X2)
			CH1: Do not set input X1 as high–speed counter	CH1	Do not set input X1 as high-speed counter. Incremental input (X1) Incremental input (X1), reset input (X2) Decremental input (X1) Decremental input (X1), reset input (X2)
	401	High-speed counter operation mode settings (X3 to X5)	CH2: Do not set input X3 as high–speed counter	CH2	Do not set input X3 as high-speed counter. Two-phase input (X3, X4) Two-phase input (X3, X4), reset input (X5) Incremental input (X3) Incremental input (X3), reset input (X5) Decremental input (X3) Decremental input (X3), reset input (X5) Incremental/decremental input (X3, X4) Incremental/decremental input (X3, X4), reset input (X5) Incremental/decremental control input (X3, X4) Incremental/decremental control input (X3, X4), reset input (X5)
			CH3: Do not set input X4 as high–speed counter	CH3	Do not set input X4 as high-speed counter. Incremental input (X4) Incremental input (X4), reset input (X5) Decremental input (X4) Decremental input (X4), reset input (X5)

Item	No.	Name	Default value	Descriptions
Inter-rupt input	**402**	Pulse catch input settings	Not set	X0 X1 X2 X3 X4 X5 X6 X7 Specify the input contacts used as pulse catch input.
	403	Interrupt input settings	Not set	X0 X1 X2 X3 X4 X5 X6 X7 Specify the input contacts used as interrupt input. X0 X1 X2 X3 X4 X5 X6 X7 Specify the effective interrupt edge. (When set: on → off is valid)

Notes

- **If the operation mode is set to two–phase, incremental/decremental, or incremental/decremental control, the setting for CH1 is invalid in part 2 of system register 400 and the setting for CH3 is invalid in part 2 of system register 401.**
- **If reset input settings overlap, the CH1 setting takes precedence in system register 400 and the CH3 setting takes precedence in system register 401.**
- **The settings for pulse catch and interrupt input can only be specified in system registers 402 and 403.**
- **If system registers 400 to 403 have been set simultaneously for the same input relay, the following precedence order is effective:**
  1. High–speed counter
  2. Pulse catch
  3. Interrupt input.
  This means, the counter keeps counting even after an interrupt. However, the response time of the high–speed counter is about 100 μs, that of the pulse catch input is about 200 μs. Therefore, the interrupt is recognized quickly enough.

Item	No.	Name	Default value	Descriptions
Tool port setting	**410**	Unit no. setting	1	1 to 99
	412	Selection of modem connection	Disabled	Enabled/Disabled
	413	Communication format setting	Data length: 8 bits, Parity check: "with, odd" Stop bit: 1 bit	Enter the settings for the various items. Data length: 7bits/8bits Parity check: none/with odd/with even Stop bit: 1bit/2bits
	415	Communication speed (Baud rate) setting	9600 bps	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
COM. 1 port setting	**410**	Unit no. setting	1	0 to 99
	412	Communication mode setting	Computer link	Computer link General–purpose serial communication PLC link
		Selection of modem connection	Disabled	Enabled/Disabled
	413	Communication format setting	Data length: 8 bits, Parity check: "with, odd" Stop bit: 1 bit	Enter the settings for the various items. Data length: 7bits/8bits Parity check: none/with odd/with even Stop bit: 1bit/2bits The following setting is valid only when the communication mode specified by system register 412 has been set to "General–purpose serial communication". Terminator: CR/CR+LF/None Header: STX not exist/STX exist
	415	Communication speed (Baud rate) setting	9600 bps	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
	416	Starting address for received buffer of general (serial data) communication mode	0	0 to 32764
	417	Buffer capacity setting for data received of general (serial data) communication mode	2048	0 to 2048

Note

The communication format in a PLC link is fixed at the following settings:
Data length 8 bits, odd parity, stop bit 1.
The communication speed (baud rate) is fixed at 115,200 bps.

Item	No.	Name	Default value	Descriptions
COM. 2 port setting	**411**	Unit no. setting	1	1 to 99
	412	Communication mode setting	Computer link	Computer link General–purpose serial communication
		Selection of modem connection	Disabled	Enabled/Disabled
	414	Communication format setting	Data length: 8 bits, Parity check: “with, odd” Stop bit: 1 bit	Enter the settings for the various items. Data length: 7bits/8bits Parity check: none/with odd/with even Stop bit: 1bit/2bits The following setting is valid only when the communication mode specified by system register 412 has been set to “General–purpose serial communication”. Terminator: CR/CR+LF/None Header: STX not exist/STX exist
	415	Communication speed (Baud rate) setting	9600 bps	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
	418	Starting address for received buffer of general (serial data) communication mode	2048	0 to 32764
	419	Buffer capacity setting for data received of general (serial data) communication mode	2048	0 to 2048

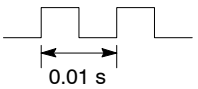
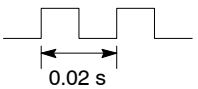
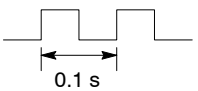
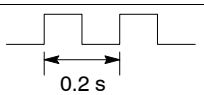
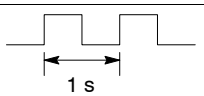
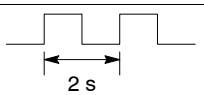
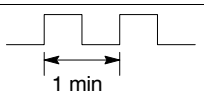
Note

The communication format in a PLC link is fixed at the following settings:
Data length 8 bits, odd parity, stop bit 1.
The communication speed (baud rate) is fixed at 115,200 bps.

B.4 Table of Special Internal Relays

The special internal relays turn on and off under special conditions. The ON and OFF states are not output externally. Writing is not possible with a programming tool or an instruction.

Relay No.: **Matsushita** IEC	**Name**	**Description**
R9000 %MX0.900.0	Self-diagnostic error flag	Turns on when a self-diagnostic error occurs. The content of self-diagnostic error is stored in DT90000.
R9001 %MX0.900.1	Not used	———
R9002 %MX0.900.2	Not used	———
R9003 %MX0.900.3	Not used	———
R9004 %MX0.900.4	I/O verification error flag	Turns on when an I/O verification error occurs.
R9005 %MX0.900.5	Backup battery error flag (non-hold)	Turns on for an instant when a backup battery error occurs.
R9006 %MX0.900.6	Backup battery error flag (hold)	Turns on and keeps the on state when a backup battery error occurs. Once a battery error has been detected, this is held even after recovery has been made. It goes off if the power supply is turned off, or if the system is initialized.
R9007 %MX0.900.7	Operation error flag (hold)	Turns on and keeps the on state when an operation error occurs. The address where the error occurred is stored in DT90017. (Indicates the first operation error which occurred.)
R9008 %MX0.900.8	Operation error flag (non-hold)	Turns on for an instant when an operation error occurs. The address where the operation error occurred is stored in DT90018. The contents change each time a new error occurs.
R9009 %MX0.900.9	Carry flag	This is set if an overflow or underflow occurs in the calculation results, and as a result of a shift system instruction being executed.
R900A %MX0.900.10	> flag	Turns on for an instant when the compared results become larger in the comparison instructions.
R900B %MX0.900.11	= flag	Turns on for an instant, – when the compared results are equal in the comparison instructions. – when the calculated results become 0 in the arithmetic instructions.
R900C %MX0.900.12	< flag	Turns on for an instant when the compared results become smaller in the comparison instructions".
R900D %MX0.900.13	Auxiliary timer instruction flag	Turns on when the set time elapses (set value reaches 0) in the timing operation of the **F137 (STMR)**/**F183 (DSTM)** auxiliary timer instruction. This flag turns off when the trigger for auxiliary timer instruction turns off.
R900E %MX0.900.14	Tool port communication error	Turns on when a communication error at the Tool port has occurred.
R900F %MX0.900.15	Constant scan error flag	Turns on when the scan time exceeds the time specified in system register 34 during constant scan execution. This goes on if 0 has been set using system register 34.

Relay No.: Matsushita IEC	**Name**	**Description**
R9010 %MX0.901.0	Always on relay	Always on.
R9011 %MX0.901.1	Always off relay	Always off.
R9012 %MX0.901.2	Scan pulse relay	Turns on and off alternately at each scan
R9013 %MX0.901.3	Initial (on type) pulse relay	Goes on for only the first scan after operation (RUN) has been started, and goes off for the second and subsequent scans.
R9014 %MX0.901.4	Initial (off type) pulse relay	Goes off for only the first scan after operation (RUN) has been started, and goes on for the second and subsequent scans.
R9015 %MX0.901.5	Step ladder initial pulse relay (on type)	Turns on for an instant only in the first scan of the process the moment the step ladder process is opened.
R9016 %MX0.901.6	Not used	—
R9017 %MX0.901.7	Not used	—
R9018 %MX0.901.8	0.01 s clock pulse relay	Repeats on/off operations in 0.01 s cycles. 
R9019 %MX0.901.9	0.02 s clock pulse relay	Repeats on/off operations in 0.02 s cycles. 
R901A %MX0.901.10	0.1 s clock pulse relay	Repeats on/off operations in 0.1 s cycles. 
R901B %MX0.901.11	0.2 s clock pulse relay	Repeats on/off operations in 0.2 s cycles. 
R901C %MX0.901.12	1 s clock pulse relay	Repeats on/off operations in 1 s cycles. 
R901D %MX0.901.13	2 s clock pulse relay	Repeats on/off operations in 2 s cycles. 
R901E %MX0.901.14	1 min clock pulse relay	Repeats on/off operations in 1 min cycles. 
R901F %MX0.901.15	Not used	—

Relay No.: **Matsushita** IEC	**Name**	**Description**
R9020 %MX0.902.0	RUN mode flag	Turns off while the mode selector is set to PROG. Turns on while the mode selector is set to RUN.
R9021 %MX0.902.1	Not used	———
R9022 %MX0.902.2	Not used	———
R9023 %MX0.902.3	Not used	———
R9024 %MX0.902.4	Not used	———
R9025 %MX0.902.5	Not used	———
R9026 %MX0.902.6	Message flag	Turns on while the **F149 (MSG)** instruction is executed.
R9027 %MX0.902.7	Not used	———
R9028 %MX0.902.8	Not used	———
R9029 %MX0.902.9	Forcing flag	Turns on during forced on/off operation for input/output relay and timer/counter contacts.
R902A %MX0.902.10	Interrupt enable flag	Turns on while the external interrupt trigger is enabled by the **ICTL** instruction.
R902B %MX0.902.11	Interrupt error flag	Turns on when an interrupt error occurs.
R902C %MX0.902.12	Not used	———
R902D %MX0.902.13	Not used	———
R902E %MX0.902.14	Not used	———
R902F %MX0.902.15	Not used	———

Relay No.: Matsushita IEC	**Name**		**Description**
R9030 %MX0.903.0	Not used		———
R9031 %MX0.903.1	Not used		———
R9032 %MX0.903.2	COM port 1 communication mode flag		Turns on when the general–purpose communication function is being used. Goes off when the MEWTOCOL–COM or the PLC link function is being used.
R9033 %MX0.903.3	Print instruction execution flag		Off: Printing is not executed. On: Execution is in progress.
R9034 %MX0.903.4	Run overwrite complete flag		Goes on for only the first scan following completion of a rewrite during RUN operation.
R9035 %MX0.903.5	Not used		———
R9036 %MX0.903.6	Not used		———
R9037 %MX0.903.7	COM port 1 communication error flag		Goes on if a transmission error occurs during data communication. Goes off when a request is made to send data, using the **F159 (MTRN)** instruction.
R9038 %MX0.903.8	COM port 1 reception done flag during general–purpose serial communication		Turns on when the terminator is received during general–purpose serial communication.
R9039 %MX0.903.9	COM port 1 transmission done flag during general–purpose serial communication		Goes on when transmission has been completed in general–purpose serial communication. Goes off when transmission is requested in general–purpose serial communication.
R903A %MX0.903.10	High–speed counter control flag	CH0	Turns on while the high–speed counter instructions **F166 (HC15)**, **F167 (HC1R)** and the pulse output instructions **F171 (SPDH)** to **F176 (PWMH)** are executed.
R903B %MX0.903.11	High–speed counter control flag	CH1	Turns on while the high–speed counter instructions **F166 (HC15)**, **F167 (HC1R)** and the pulse output instructions **F171 (SPDH)** to **F176 (PWMH)** are executed.
R903C %MX0.903.12	High–speed counter control flag	CH2	Turns on while the high–speed counter instructions **F166 (HC15)**, **F167 (HC1R)** and the pulse output instructions **F171 (SPDH)** to **F176 (PWMH)** are executed.
R903D %MX0.903.13	High–speed counter control flag	CH3	Turns on while the high–speed counter instructions **F166 (HC15)**, **F167 (HC1R)** and the pulse output instructions **F171 (SPDH)** to **F176 (PWMH)** are executed.
R903E %MX0.903.14	Not used		———
R903F %MX0.903.15	Not used		———

Relay No.: Matsushita IEC	**Name**	**Description**
R9040 %MX0.904.0	Not used	———
R9041 %MX0.904.1	COM port 1 PLC link flag	Turns on while the PLC link function is used.
R9042 %MX0.904.2	COM port 2 communication mode flag	Goes on when general–purpose serial communication is used. Goes off when MEWTOCOL is used.
R9043 to R9046 %MX0.904.3 to %MX0.904.6	Not used	———
R9047 %MX0.904.7	COM port 2 communication error flag	Goes on if a transmission error occurs during data communication. Goes off when a request is made to send data using the **F159 (MTRN)** instruction.
R9048 %MX0.904.8	COM port 2 reception done flag during general purpose communication	Turns on when the terminator is received during general–purpose serial communication.
R9049 %MX0.904.9	COM port 2 transmission done flag during general purpose communication	Goes on when transmission has been completed in general–purpose serial communication. Goes off when transmission is requested in general–purpose communication.
R904A to R904D %MX0.904.10 to %MX0.904.13	Not used	———
R904E %MX0.904.14	Circular interpolation control in progress flag	This flag is set when circular interpolation instruction F176 is run. This state is maintained until the target value is achieved. While this flag is set, other positioning instructions (F171 to F176) cannot be run.
R904F %MX0.904.15	Circular interpolation data overwrite confirmation flag	This flag is set when circular interpolation instruction F176 is run. It is cleared when the instruction at the same address is run. This is used to overwrite data in continuous mode, where circular interpolation is conducted continuously.
R9050 %MX0.905.0	MEWNET–W0 PLC link transmission error flag	When using MEWNET-W0 – turns on when a transmission error occurs in a PLC link. – turns on when there is an error in the PLC link area settings.
R9051 to R905F %MX0.905.1 to %MX0.905.15	Not used	———

Relay No.: Matsushita IEC	Name		Description
R9060 %MX0.906.0	MEWNET–W0 PLC link transmission assurance relay	Unit no. 1	Turns on when unit no. 1 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9061 %MX0.906.1		Unit no. 2	Turns on when unit no. 2 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9062 %MX0.906.2		Unit no. 3	Turns on when unit no. 3 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9063 %MX0.906.3		Unit no. 4	Turns on when unit no. 4 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9064 %MX0.906.4		Unit no. 5	Turns on when unit no. 5 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9065 %MX0.906.5		Unit no. 6	Turns on when unit no. 6 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9066 %MX0.906.6		Unit no. 7	Turns on when unit no. 7 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9067 %MX0.906.7		Unit no. 8	Turns on when unit no. 8 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error is occurs, or when not in PLC link mode.
R9068 %MX0.906.8		Unit no. 9	Turns on when unit no. 9 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R9069 %MX0.906.9		Unit no. 10	Turns on when unit no. 10 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R906A %MX0.906.10		Unit no. 11	Turns on when unit no. 11 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R906B %MX0.906.11		Unit no. 12	Turns on when unit no. 12 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R906C %MX0.906.12		Unit no. 13	Turns on when unit no. 13 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R906D %MX0.906.13		Unit no. 14	Turns on when unit no. 14 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R906E %MX0.906.14		Unit no. 15	Turns on when unit no. 15 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.
R906F %MX0.906.15		Unit no. 16	Turns on when unit no. 16 is communicating properly in PLC link mode. Turns off when operation is stopped, when an error occurs, or when not in PLC link mode.

Relay No.: **Matsushita** IEC	**Name**		**Description**
R9070 %MX0.907.0	MEWNET–W0 PLC link operation mode relay	Unit no. 1	Turns on when unit no. 1 is in RUN mode. Turns off when unit no. 1 is in PROG mode.
R9071 %MX0.907.1		Unit no. 2	Turns on when unit no. 2 is in RUN mode. Turns off when unit no. 2 is in PROG mode.
R9072 %MX0.907.2		Unit no. 3	Turns on when unit no. 3 is in RUN mode. Turns off when unit no. 3 is in PROG mode.
R9073 %MX0.907.3		Unit no. 4	Turns on when unit no. 4 is in RUN mode. Turns off when unit no. 4 is in PROG mode.
R9074 %MX0.907.4		Unit no. 5	Turns on when unit no. 5 is in RUN mode. Turns off when unit no. 5 is in PROG mode.
R9075 %MX0.907.5		Unit no. 6	Turns on when unit no. 6 is in RUN mode. Turns off when unit no. 6 is in PROG mode.
R9076 %MX0.907.6		Unit no. 7	Turns on when unit no. 7 is in RUN mode. Turns off when unit no. 7 is in PROG mode.
R9077 %MX0.907.7		Unit no. 8	Turns on when unit no. 8 is in RUN mode. Turns off when unit no. 8 is in PROG mode.
R9078 %MX0.907.8		Unit no. 9	Turns on when unit no. 9 is in RUN mode. Turns off when unit no. 9 is in PROG mode.
R9079 %MX0.907.9		Unit no. 10	Turns on when unit no. 10 is in RUN mode. Turns off when unit no. 10 is in PROG mode.
R907A %MX0.907.10		Unit no. 11	Turns on when unit no. 11 is in RUN mode. Turns off when unit no. 11 is in PROG mode.
R907B %MX0.907.11		Unit no. 12	Turns on when unit no. 12 is in RUN mode. Turns off when unit no. 12 is in PROG mode.
R907C %MX0.907.12		Unit no. 13	Turns on when unit no. 13 is in RUN mode. Turns off when unit no. 13 is in PROG mode.
R907D %MX0.907.13		Unit no. 14	Turns on when unit no. 14 is in RUN mode. Turns off when unit no. 14 is in PROG mode.
R907E %MX0.907.14		Unit no. 15	Turns on when unit no. 15 is in RUN mode. Turns off when unit no. 15 is in PROG mode.
R907F %MX0.907.15		Unit no. 16	Turns on when unit no. 16 is in RUN mode. Turns off when unit no. 16 is in PROG mode.

B.5 Table of Special Data Registers

The special data registers are one word (16-bit) memory areas which store specific information.

(A: Available, N/A: Not available)

Address **Matsushita** IEC	**Name**	**Description**	**Reading**	**Writing**
DT90000 %MW5.90000	Self–diagnostic error code	The self-diagnostic error code is stored here when a self-diagnostic error occurs.	A	N/A
DT90001 %MW5.90001	Not used	———	N/A	N/A
DT90002 %MW5.90002	Position of abnormal I/O unit for FPΣ left side expansion	When an error occurs at an FPΣ expansion I/O unit, the bit corresponding to the unit no. will turn on. Monitor using binary display. 15 11 7 3 2 1 0 (bit no.) 3 2 1 0 (unit no.) on: error, off: normal	A	N/A
DT90003 %MW5.90003	Not used	———	N/A	N/A
DT90004 %MW5.90004	Not used	———		
DT90005 %MW5.90005	Not used	———		
DT90006 %MW5.90006	Position of abnormal intelligent unit for FPΣ left side expansion	When an error condition is detected in an intelligent unit, the bit corresponding to the unit no. will turn on. Monitor using binary display. 15 11 7 3 2 1 0 (bit no.) 3 2 1 0 (unit no.) on : error, off: normal	A	N/A
DT90007 %MW5.90007	Not used	———	N/A	N/A
DT90008 %MW5.90008	Not used	———		
DT90009 %MW5.90009	Communication error flag for COM 2	Stores the error contents when using COM port 2.	A	N/A
DT90010 %MW5.90010	Position of I/O verify error unit for FP0 right side expansion	When the state of installation of an FP0 expansion I/O unit has changed since the power was turned on, the bit corresponding to the unit no. will turn on. Monitor using binary display. 15 11 7 3 2 1 0 (bit no.) 2 1 0 (unit no.) on: error, off: normal		

(A: Available, N/A: Not available)

Address Matsushita IEC	Name	Description	Reading	Writing
DT90011 %MW5.90011	Position of I/O verify error unit for FPΣ left side expansion	When the state of installation of an FPΣ expansion I/O unit has changed since the power was turned on, the bit corresponding to the unit no. will turn on. Monitor using binary display. 15 11 7 3 2 1 0 (bit no.)  3 2 1 0 (unit no.) on: error, off: normal	A	N/A
DT90012 %MW5.90012	Not used	———	N/A	N/A
DT90013 %MW5.90013	Not used	———		
DT90014 %MW5.90014	Operation auxiliary register for data shift instruction	One shift-out hexadecimal digit is stored in bit positions 0 to 3 when the data shift instruction **F105 (BSR)** or **F106 (BSL)** is executed. The value can be read and written by executing the **F0 (MV)** instruction.	A	N/A
DT90015 %MW5.90015	Operation auxiliary register for division instruction	The divided remainder (16-bit) is stored in DT90015 when the division instruction **F32 (%)** or **F52 (B%)** instruction is executed. The divided remainder (32-bit) is stored in DT90015 and DT90016 when the division instruction **F33 (D%)** or **F53 (DB%)** is executed. The value can be read and written by executing the **F0 (MV)** instruction.		
DT90016 %MW5.90016				
DT90017 %MW5.90017	Operation error address (hold type)	After commencing operation, the address where the first operation error occurred is stored. Monitor the address using decimal display.		
DT90018 %MW5.90018	Operation error address (non-hold type)	The address where an operation error occurred is stored. Each time an error occurs, the new address overwrites the previous address. At the beginning of a scan, the address is 0. Monitor the address using decimal display.		
DT90019 %MW5.90019	2.5ms ring counter	The data stored here is increased by one every 2.5ms. (H0 to HFFFF) Difference between the values of the two points (absolute value) × 2.5ms = elapsed time between the two points.		
DT90020 %MW5.90020	Not used	———	N/A	N/A
DT90021 %MW5.90021	Not used	———		
DT90022 %MW5.90022	Scan time (current value) (see note)	The current scan time is stored here. The scan time is calculated using the formula: Scan time (ms) = stored data (decimal) × 0.1ms Example: K50 indicates 5ms.	A	N/A

(A: Available, N/A: Not available)

Address Matsushita IEC	Name	Description	Reading	Writing
DT90023 %MW5.90023	Scan time (minimum value) (see note)	The minimum scan time is stored here. The scan time is calculated using the formula: Scan time (ms) = stored data (decimal) × 0.1ms Example: K50 indicates 5ms.	A	N/A
DT90024 %MW5.90024	Scan time (maximum value) (see note)	The maximum scan time is stored here. The scan time is calculated using the formula: Scan time (ms) = stored data (decimal) × 0.1ms Example: K125 indicates 12.5ms.		
DT90025 %MW5.90025	Mask condition monitoring register for interrupts (INT 0 to 7)	The mask conditions of interrupts using the instruction can be stored here. Monitor usin binary display. 15 11 7 3 0 (Bit no.) 23 19 16 (INT no.) 0: interrupt disabled (masked) 1: interrupt enabled (unmasked)		
DT90026 %MW5.90026	Not used	———	N/A	N/A
DT90027 %MW5.90027	Periodical interrupt interval (INT 24)	The value set by the **ICTL** instruction is stored. – K0: periodical interrupt is not used – K1 to K3000: 0.5ms to 1.5s or 10ms to 30s	A	N/A
DT90028 %MW5.90028	Not used	———	N/A	N/A
DT90029 %MW5.90029	Not used	———		
DT90030 %MW5.90030	Message 0	The contents of the specified message are stored in these special data registers when the **F149 (MSG)** instruction is executed.	A	N/A
DT90031 %MW5.90031	Message 1			
DT90032 %MW5.90032	Message 2			
DT90033 %MW5.90033	Message 3			
DT90034 %MW5.90034	Message 4			
DT90035 %MW5.90035	Message 5			

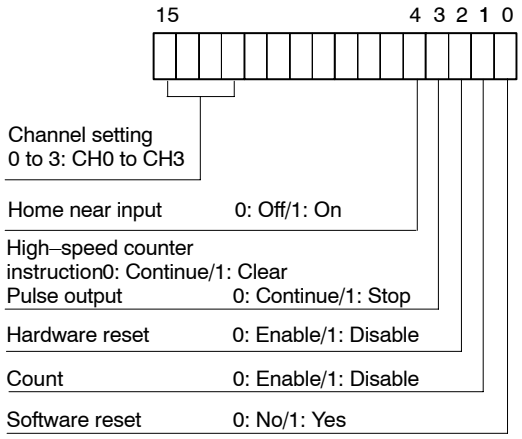
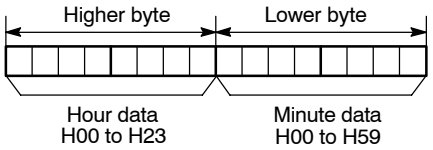
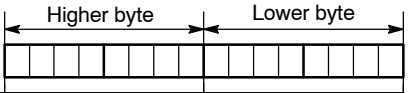
Note

Scan time display is only possible in RUN mode and shows the operation cycle time. (In PROG mode, the scan time for the operation is not displayed.) The maximum and minimum values are cleared each time the mode is switched from RUN to PROG.

(A: Available, N/A: Not available)

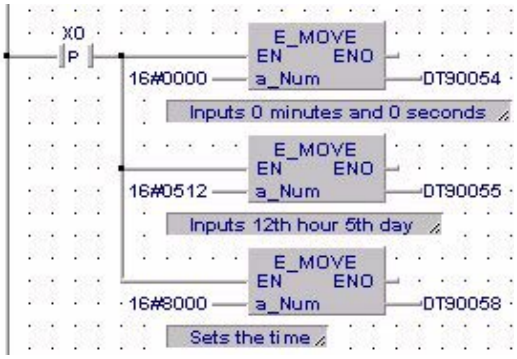
Address Matsushita IEC	Name		Description	Reading	Writing
DT90036 %MW5.90036	Not used		———	N/A	N/A
DT90037 %MW5.90037	Operation auxiliary register for search instruction **F96 (SRC)**		The number of data that match the searched data is stored here when the **F96 (SRC)** instruction is executed.	A	N/A
DT90038 %MW5.90038	Operation auxiliary register for search instruction **F96 (SRC)**		The position of the first matching data is stored here when the **F96 (SRC)** instruction is executed.		
DT90039 %MW5.90039	Not used		———	N/A	N/A
DT90040 %MW5.90040	Potentiometer (volume) input V0		The potentiometer value (K0 to K1000) is stored here. This value can be used in analog timers and other applications by using the program to read this value to a data register. V0→DT90040 V1→DT90041	A	N/A
DT90041 %MW5.90041	Potentiometer (volume) input V1				
DT90042 %MW5.90042	———		Used by the system.	N/A	N/A
DT90043 %MW5.90043	———		Used by the system.		
DT90044 %MW5.90044	High-speed counter elapsed value	For CH0	The elapsed value (32–bit data) for the high–speed counter is stored here. The value can be read and written by executing the **F1 (DMV)** instruction.	A	A
DT90045 %MW5.90045					
DT90046 %MW5.90046	High-speed counter target value	For CH0	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions to be used when the high–speed counter related instruction **F166, F167, F171, F175** or **F176** is executed. The value can be read by executing the **F1 (DMV)** instruction.	A	N/A
DT90047 %MW5.90047					
DT90048 %MW5.90048	High-speed counter elapsed value area	For CH1	The elapsed value (32–bit data) for the high–speed counter is stored here. The value can be read and written by executing the **F1 (DMV)**instruction.	A	A
DT90049 %MW5.90049					
DT90050 %MW5.90050	High-speed counter target value area	For CH1	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions to be used when the high–speed counter related instruction **F166** or **F167** is executed. The value can be read by executing the **F1 (DMV)** instruction.	A	N/A
DT90051 %MW5.90051					

(A: Available, N/A: Not available)

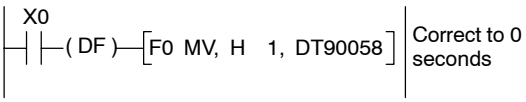
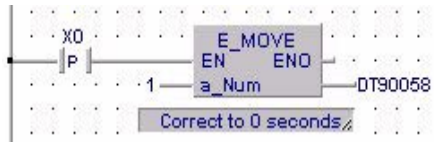
Address Matsushita IEC	Name	Description	Reading	Writing
DT90052 %MW5.90052	High–speed counter and pulse output control flag	A value can be written with the **F0 (MV)** instruction to reset the high-speed counter, disable counting, continue or clear the high-speed counter instruction. Control code setting 	N/A	A
DT90053 %MW5.90053	Clock/calendar monitor (hour/minute)	Hour and minute data of the clock/calendar are stored here. This data is read-only data, it cannot be overwritten. 	A	N/A
DT90054 %MW5.90054	Clock/calendar setting (minute/second)	The year, month, day, hour, minute, second, and day-of-the-week data for the calendar timer is stored. The built-in calendar timer will operate correctly through the year 2099 and supports leap years. The calendar timer can be set by writing a value using a programming tool software or a program that uses the **F0 (MV)** instruction (see example for DT90058). 	A	A
DT90055 %MW5.90055	Clock/calendar setting (day/hour)			
DT90056 %MW5.90056	Clock/calendar setting (year/month)			
DT90057 %MW5.90057	Clock/calendar setting (day-of-the-week)			

DT90054	Minute data H00 to H59	Second data H00 to H59
DT90055	Day data H01 to H31	Hour data H00 to H23
DT90056	Year data H00 to H99	Month data H01 to H12
DT90057	———	Day-of-the-week data H00 to H06

(A: Available, N/A: Not available)

Address Matsushita IEC	Name	Description	Reading	Writing
DT90058 %MW5.90058	Clock/calendar time setting and 30 seconds correction register	1. Setting time and date By setting the highest bit of DT90058 to 1, the time becomes that written to DT90054 to DT90057 by the **F0 (MV)** instruction. After the time is set, DT90058 is cleared to 0. (Cannot be performed with any instruction other than the **F0 (MV)** instruction.) ✐ Example: Set the time to 12:00:00 on the 5th day when X0 turns ON. **FPWIN GR:** X0 (DF) [F0 MV, H 0, DT90054] Inputs 0 min. and 0 sec. [F0 MV, H 512, DT90055] Inputs 12th hour 5th day [F0 MV, H8000, DT90058] Sets the time **FPWIN Pro:**  If you changed the values of DT90054 to DT90057 with the programming tool software, the time will be set when the new values are written. Therefore, it is unnecessary to write to DT90058.	A	A

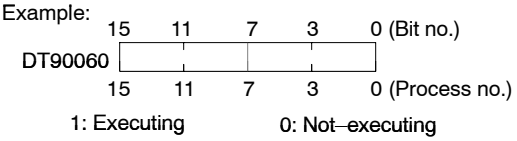
(A: Available, N/A: Not available)

Address Matsushita IEC	Name	Description	Reading	Writing
DT90058 %MW5.90058 **(cont.)**	Clock/calendar time setting and 30 seconds correction register	2. The correcting time is less than 30 seconds By setting the lowest bit of DT90058 to 1, the value will be moved up or down and become exactly 0 seconds. After the correction is completed, DT90058 is cleared to 0. ✐ Example: Correct to 0 seconds when X0 turns ON. **FPWIN GR:**  **FPWIN Pro:**  At the time of correction, if between 0 and 29 seconds, the time will be moved down, and if between 30 and 59 seconds, it will be moved up. In the example above, if the time was 5 minutes 29 seconds, it will become 5 minutes 0 seconds; and, if the time was 5 minutes 35 seconds, it will become 6 minutes 0 seconds.	A	A

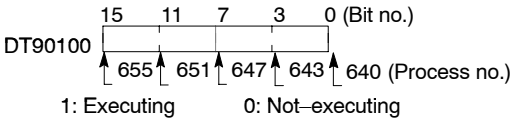
(A: Available, N/A: Not available)

Address Matsushita IEC	Name	Description	Reading	Writing
DT90059 %MW5.90059	Serial communication error code	Error code is stored here when a communication error occurs.	N/A	N/A
DT90060 %MW5.90060	Step ladder process (0 to 15)	Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on. Monitor using binary display. Example: 15 11 7 3 0 (Bit no.) DT90060 [ ][ ][ ][ ] 15 11 7 3 0 (Process no.) 1: Executing 0: Not–executing A programming tool software can be used to write data.	A	A
DT90061 %MW5.90061	Step ladder process (16 to 31)			
DT90062 %MW5.90062	Step ladder process (32 to 47)			
DT90063 %MW5.90063	Step ladder process (48 to 63)			
DT90064 %MW5.90064	Step ladder process (64 to 79)			
DT90065 %MW5.90065	Step ladder process (80 to 95)			
DT90066 %MW5.90066	Step ladder process (96 to 111)			
DT90067 %MW5.90067	Step ladder process (112 to 127)			
DT90068 %MW5.90068	Step ladder process (128 to 143)			
DT90069 %MW5.90069	Step ladder process (144 to 159)			
DT90070 %MW5.90070	Step ladder process (160 to 175)			
DT90071 %MW5.90071	Step ladder process (176 to 191)			
DT90072 %MW5.90072	Step ladder process (192 to 207)			
DT90073 %MW5.90073	Step ladder process (208 to 223)			
DT90074 %MW5.90074	Step ladder process (224 to 239)			
DT90075 %MW5.90075	Step ladder process (240 to 255)			
DT90076 %MW5.90076	Step ladder process (256 to 271)			
DT90077 %MW5.90077	Step ladder process (272 to 287)			
DT90078 %MW5.90078	Step ladder process (288 to 303)			
DT90079 %MW5.90079	Step ladder process (304 to 319)			

(A: Available, N/A: Not available)

Address Matsushita IEC	Name	Description	Reading	Writing
DT90080 %MW5.90080	Step ladder process (320 to 335)	Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on. Monitor using binary display. Example:  A programming tool software can be used to write data.	A	A
DT90081 %MW5.90081	Step ladder process (336 to 351)			
DT90082 %MW5.90082	Step ladder process (352 to 367)			
DT90083 %MW5.90083	Step ladder process (368 to 383)			
DT90084 %MW5.90084	Step ladder process (384 to 399)			
DT90085 %MW5.90085	Step ladder process (400 to 415)			
DT90086 %MW5.90086	Step ladder process (416 to 431)			
DT90087 %MW5.90087	Step ladder process (432 to 447)			
DT90088 %MW5.90088	Step ladder process (448 to 463)			
DT90089 %MW5.90089	Step ladder process (464 to 479)			
DT90090 %MW5.90090	Step ladder process (480 to 495)			
DT90091 %MW5.90091	Step ladder process (496 to 511)			
DT90092 %MW5.90092	Step ladder process (512 to 527)			
DT90093 %MW5.90093	Step ladder process (528 to 543)			
DT90094 %MW5.90094	Step ladder process (544 to 559)			
DT90095 %MW5.90095	Step ladder process (560 to 575)			
DT90096 %MW5.90096	Step ladder process (576 to 591)			
DT90097 %MW5.90097	Step ladder process (592 to 607)			
DT90098 %MW5.90098	Step ladder process (608 to 623)			
DT90099 %MW5.90099	Step ladder process (624 to 639)			

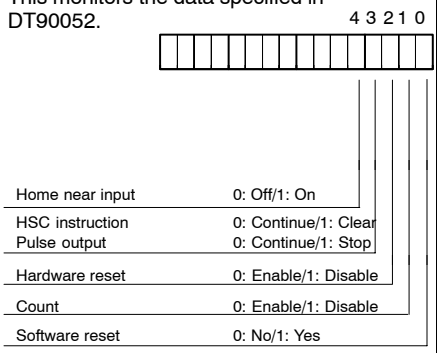
(A: Available, N/A: Not available)

Address Matsushita IEC	Name	Description	Reading	Writing
DT90100 %MW5.900100	Step ladder process (640 to 655)	Indicates the startup condition of the step ladder process. When the process starts up, the bit corresponding to the process number turns on. Monitor using binary display. Example:  A programming tool software can be used to write data.	A	A
DT90101 %MW5.900101	Step ladder process (656 to 671)			
DT90102 %MW5.900102	Step ladder process (672 to 687)			
DT90103 %MW5.900103	Step ladder process (688 to 703)			
DT90104 %MW5.900104	Step ladder process (704 to 719)			
DT90105 %MW5.900105	Step ladder process (720 to 735)			
DT90106 %MW5.900106	Step ladder process (736 to 751)			
DT90107 %MW5.900107	Step ladder process (752 to 767)			
DT90108 %MW5.900108	Step ladder process (768 to 783)			
DT90109 %MW5.900109	Step ladder process (784 to 799)			
DT90110 %MW5.900110	Step ladder process (800 to 815)			
DT90111 %MW5.900111	Step ladder process (816 to 831)			
DT90112 %MW5.900112	Step ladder process (832 to 847)			
DT90113 %MW5.900113	Step ladder process (848 to 863)			
DT90114 %MW5.900114	Step ladder process (864 to 879)			
DT90115 %MW5.900115	Step ladder process (880 to 895)			
DT90116 %MW5.900116	Step ladder process (896 to 911)			
DT90117 %MW5.900117	Step ladder process (912 to 927)			
DT90118 %MW5.900118	Step ladder process (928 to 943)			
DT90119 %MW5.900119	Step ladder process (944 to 959)			
DT90120 %MW5.900120	Step ladder process (960 to 975)			
DT90121 %MW5.900121	Step ladder process (976 to 991)			
DT90122 %MW5.900122	Step ladder process (992 to 999) (Higher byte: not used)			

(A: Available, N/A: Not available)

Address **Matsushita** IEC	**Name**	**Description**	**Reading**	**Writing**
DT90123 to DT90125 %MW5.90123 to %MW5.90125	Not used	———	N/A	N/A
DT90126 %MW5.90126	Forced Input/ Output unit no.	Used by the system.		
DT90127 to DT90139 %MW5.90127 to %MW5.90139	Not used	———		
DT90140 %MW5.90140	MEWNET–W0 PLC link status	The number of times the receiving operation is performed.	A	N/A
DT90141 %MW5.90141		The current interval between two receiving operations: value in the register × 2.5ms		
DT90142 %MW5.90142		The minimum interval between two receiving operations: value in the register × 2.5ms		
DT90143 %MW5.90143		The maximum interval between two receiving operations: value in the register × 2.5ms		
DT90144 %MW5.90144		The number of times the sending operation is performed.		
DT90145 %MW5.90145		The current interval between two sending operations: value in the register × 2.5ms		
DT90146 %MW5.90146		The minimum interval between two sending operations: value in the register × 2.5ms		
DT90147 %MW5.90147		The maximum interval between two sending operations: value in the register × 2.5ms		
DT90148 to DT90155 %MW5.90148 to %MW5.90155	Not used	———	N/A	N/A
DT90156 %MW5.90156	MEWNET–W0 PLC link status	Area used for measurement of receiving interval.	A	N/A
DT90157 %MW5.90157		Area used for measurement of sending interval.		
DT90158 %MW5.90158	Not used	———	N/A	N/A
DT90159 %MW5.90159				
DT90160 %MW5.90160	MEWNET–W0 PLC link unit no.	Stores the unit no. of PLC link	A	N/A
DT90161 %MW5.90161	MEWNET–W0 PLC link error flag	Stores the error contents of PLC link		

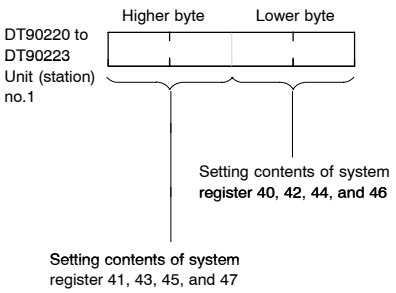
(A: Available, N/A: Not available)

Address **Matsushita** IEC	**Name**	**Description**	**Reading**	**Writing**
DT90162 to DT90169 %MW5.90162 to %MW5.90169	Not used	———	N/A	N/A
DT90170 %MW5.90170	MEWNET–W0 PLC link status	Duplicated destination for PLC inter–link address	A	N/A
DT90171 %MW5.90171		Counts how many times a token is lost.		
DT90172 %MW5.90172		Counts how many times two or more tokens are detected.		
DT90173 %MW5.90173		Counts how many times a signal is lost.		
DT90174 %MW5.90174		No. of times undefined commands have been received		
DT90175 %MW5.90175		No. of times sum check errors have occurred during reception		
DT90176 %MW5.90176		No. of times format errors have occurred in received data		
DT90177 %MW5.90177		No. of times transmission errors have occurred		
DT90178 %MW5.90178		No. of times procedural errors have occurred		
DT90179 %MW5.90179		No. of times overlapping parent units have occurred		
DT90180 to DT90189 %MW5.90180 to %MW5.90189	Not used	———	N/A	N/A
DT90190 %MW5.90190	High–speed counter control flag monitor for CH0	This monitors the data specified in DT90052. 	A	N/A
DT90191 %MW5.90191	High–speed counter control flag monitor for CH1			
DT90192 %MW5.90192	High–speed counter control flag monitor for CH2			
DT90193 %MW5.90193	High–speed counter control flag monitor for CH3			
DT90194 to DT90199 %MW5.90194 to %MW5.90199	Not used	———	N/A	N/A

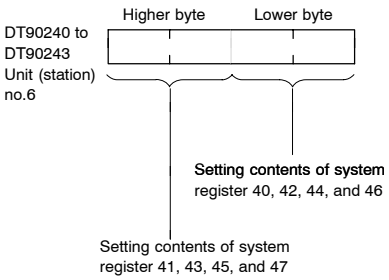
(A: Available, N/A: Not available)

Address **Matsushita** IEC	**Name**		**Description**	**Reading**	**Writing**
DT90200 %MW5.90200 **DT90201** %MW5.90201	High–speed counter elapsed value	For CH2	The elapsed value (32–bit data) for the high–speed counter is stored here. The value can be read and written by executing the **F1 (DMV)** instruction.	A	A
DT90202 %MW5.90202 **DT90203** %MW5.90203	High–speed counter target value	For CH2	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions, to be used when the high–speed counter related instruction **F166, F167, F171, F175** or **F176** is executed. The value can be read by executing the **F1 (DMV)** instruction.	A	N/A
DT90204 %MW5.90204 **DT90205** %MW5.90205	High–speed counter elapsed value	For CH3	The elapsed value (32–bit data) for the high–speed counter is stored here. The value can be read and written by executing the **F1 (DMV)**instruction.	A	A
DT90206 %MW5.90206 **DT90207** %MW5.90207	High–speed counter target value	For CH3	The target value (32–bit data) of the high–speed counter specified by the high–speed counter instruction is stored here. Target values have been preset for the various instructions, to be used when the high–speed counter related instruction **F166** or **F167** is executed. The value can be read by executing the **F1 (DMV)** instruction.	A	N/A
DT90208 to DT90218 %MW5.90208 to %MW5.90218	Not used		———	N/A	N/A

(A: Available, N/A: Not available)

Address Matsushita IEC	Name		Description	Reading	Writing
DT90219 %MW5.90219	Unit no. (station no.) selection for DT90220 to DT90251		0: Unit no. (station no.) 1 to 8, 1: Unit no. (station no.) 9 to 16	A	N/A
DT90220 %MW5.90220	PLC link unit (station) no. 1 or 9	System register 40 and 41	The contents of the system register settings pertaining to the PLC inter–link function for the various unit numbers are stored as shown below. Example: When DT90219 is 0  		
DT90221 %MW5.90221		System register 42 and 43			
DT90222 %MW5.90222		System register 44 and 45			
DT90223 %MW5.90223		System register 46 and 47			
DT90224 %MW5.90224	PLC link unit (station) no. 2 or 10	System register 40 and 41			
DT90225 %MW5.90225		System register 42 and 43			
DT90226 %MW5.90226		System register 44 and 45			
DT90227 %MW5.90227		System register 46 and 47			
DT90228 %MW5.90228	PLC link unit (station) no. 3 or 11	System register 40 and 41			
DT90229 %MW5.90229		System register 42 and 43			
DT90230 %MW5.90230		System register 44 and 45			
DT90231 %MW5.90231		System register 46 and 47			
DT90232 %MW5.90232	PLC link unit (station) no. 4 or 12	System register 40 and 41			
DT90233 %MW5.90233		System register 42 and 43			
DT90234 %MW5.90234		System register 44 and 45			
DT90235 %MW5.90235		System register 46 and 47			
DT90236 %MW5.90236	PLC link unit (station) no. 5 or 13	System register 40 and 41			
DT90237 %MW5.90237		System register 42 and 43			
DT90238 %MW5.90238		System register 44 and 45			
DT90239 %MW5.90239		System register 46 and 47			

(A: Available, N/A: Not available)

Address **Matsushita** IEC	**Name**	**Name**	**Description**	**Reading**	**Writing**
DT90240 %MW5.90240	PLC link unit (station) no. 6 or 14	System register 40 and 41	The contents of the system register settings pertaining to the PLC inter–link function for the various unit numbers are stored as shown below. Example: When DT90219 is 0  	A	N/A
DT90241 %MW5.90241		System register 42 and 43			
DT90242 %MW5.90242		System register 44 and 45			
DT90243 %MW5.90243		System register 46 and 47			
DT90244 %MW5.90244	PLC link unit (station) no. 7 or 15	System register 40 and 41			
DT90245 %MW5.90245		System register 42 and 43			
DT90246 %MW5.90246		System register 44 and 45			
DT90247 %MW5.90247		System register 46 and 47			
DT90248 %MW5.90248	PLC link unit (station) no. 8 or 16	System register 40 and 41			
DT90249 %MW5.90249		System register 42 and 43			
DT90250 %MW5.90250		System register 44 and 45			
DT90251 %MW5.90251		System register 46 and 47			
DT90252 to DT90255 %MW5.90252 to %MW5.90255	Not used		—	N/A	N/A
DT90256 %MW5.90256	Unit no. (station no.) switch monitor for COM port		Used by the system.	A	N/A

B.6 Table of Error Codes

This section contains the syntax check error codes and self–diagnostic error codes for the FPΣ.

B.6.1 Syntax Check Error Codes

Error code	Name	Operation status	Description and steps to take
E1 (see note)	Syntax error	Stops	A program with a syntax error has been written. **Change to PROG mode and correct the error.**
E2 (see note)	Duplicated output error	Stops	Two or more **OT(Out)** instructions and **KP(Keep)** instructions are programmed using the same relay. (This error also occurs if the same timer/counter number is being used.) **Change to PROG mode and correct the program so that one relay is not used for two or more OT and KP instructions. Or, set the duplicated output to enable in system register 20 (only for FPWIN GR).**
E3	Not paired error	Stops	For instructions which must be used in a pair such as jump (**JP** and **LBL**), one instruction is either missing or in an incorrect position. **Change to PROG mode and enter the two instructions which must be used in a pair in the correct positions.**
E4 (see note)	Parameter mismatch error	Stops	An instruction has been written which does not agree with system register settings. For example, the number setting in a program does not agree with the timer/counter range setting. **Change to PROG mode, check the system register settings, and change so that the settings and the instruction agree.**
E5 (see note)	Program area error	Stops	An instruction which must be written to a specific area (main program area or subprogram area) has been written to a different area (for example, a subroutine **SUB** to **RET** is placed before an **ED** instruction). **Change to PROG mode and enter the instruction into the correct area.**
E6 (see note)	Compile memory full error	Stops	The program stored in the FPΣ is too large to compile in the program memory. **Change to PROG. mode and reduce the total number of steps for the program.**
E7 (see note)	High–level instruction type error	Stops	In the program, high–level instructions, which execute in every scan and at the leading edge of the trigger, are programmed to be triggered by one contact. (E.g., **F0 (MV)** and **P0 (PMV)** use the same trigger continuously.) **Correct the program so that the high–level instructions executed in every scan and at the leading edge are triggered separately.**
E8	High-level instruction operand combination error	Stops	There is an incorrect operand in an instruction which requires a specific combination of operands (for example, the operands must all be of a certain type). **Enter the correct combination of operands.**



Note

In FPWIN Pro, these errors are detected by the compiler. Therefore, they are not critical.

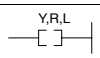
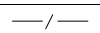
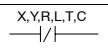
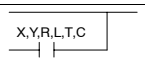
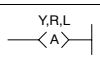
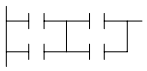
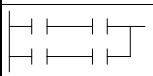
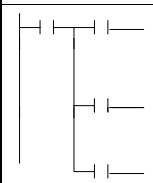
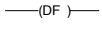
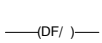
B.6.2 Self–Diagnostic Error Codes

Error code	Name		Operation status	Description and steps to take
E26	User's ROM error		Stops	Probably a hardware problem. **Please contact your dealer.**
E27	Unit installation error		Stops	The number of installed units exceeds the limit. **Turn off the power supply and check the restrictions on unit combinations.**
E28	System register error		Stops	Probably an error in the system register. **Check the system register setting.**
E30	Interrupt error 0		Stops	Probably a hardware problem. **Please contact your dealer.**
E31	Interrupt error 1		Stops	An interrupt occurred without an interrupt request. A hardware problem or error due to noise is possible. **Turn off the power and check the noise conditions.**
E32	Interrupt error 2		Stops	An interrupt occurred without an interrupt request. A hardware problem or error due to noise is possible. **Turn off the power and check the noise conditions.**
				There is no interrupt program for an interrupt which occurred. **Check the number of the interrupt program and change it to agree with the interrupt request.**
E34	I/O status error		Stops	A faulty unit is installed. **Replace the unit with a new one.**
E40	Position of abnormal I/O unit		Stops	An error in an I/O unit occurred. **Check the contents of special data register DT90002 and locate the faulty FPΣ expansion I/O unit. Then check the unit.**
E41	Intelligent unit error		Stops	An error in an intelligent unit occurred. **Check the contents of special data register DT90006 and locate the faulty FPΣ intelligent unit.**
E42	I/O unit verify error		Selectable	The connection condition of an I/O unit has changed compared to that at the time of power–up. **Check the contents of special data register DT90010 (FP0 expansion I/O unit) or DT90011 (FPΣ expansion I/O unit) and locate the faulty I/O unit.** **Set the operation status using system register 23 to continue operation.**
E45	Operation error		Selectable	Operation became impossible when a high-level instruction was executed. The causes of calculation errors vary depending on the instruction. **Set the operation status using system register 26 to continue operation.**
E50	Battery error		Selectable	The voltage of the backup battery decreased or the battery is not connected to the control unit. **Check the connection of the backup battery and replace the battery if necessary.** **This self–diagnostic error can be set with system register 4 (in this case, the ERROR/ALARM LED flashes).**
E100 to E299	Self–diagnostic error set by **F148 (ERR)** instruction	E100 to E199	Stops	The self-diagnostic error specified by the **F148 (ERR)** instruction occurred. **Take steps to clear the error condition according to the specification you chose.**
		E200 to E299	Continues	

B.7 Table of Instructions

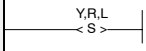
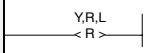
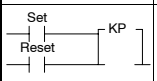
This section contains the tables of basic and high–level instructions of the Matsushita library. NAiS Control FPWIN Pro also offers the IEC standard library, which includes all IEC operators, functions and function blocks (e. g. IEC timers). Floating point arithmetic according to IEC 6113–3 is supported. Please refer to the FPWIN Pro online help or the FPΣ programming manual for detailed information.

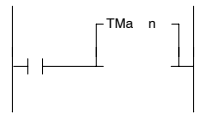
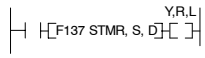
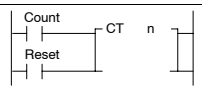
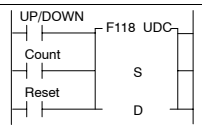
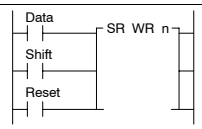
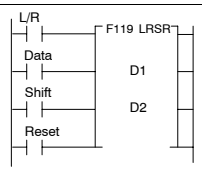
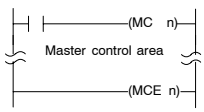
B.7.1 Table of Basic Instructions

Name	Boolean	Symbol	Description	Steps
Sequence basic instructions				
Start	**ST**		Begins a logic operation with a Form A (normally open) contact.	1 (2)
Start Not	**ST/**		Begins a logic operation with a Form B (normally closed) contact.	1 (2)
Out	**OT**		Outputs the operated result to the specified output.	1
Not	/		Inverts the operated result up to this instruction.	1
AND	**AN**		Connects a Form A (normally open) contact serially.	1 (2)
AND Not	**AN/**		Connects a Form B (normally closed) contact serially.	1 (2)
OR	**OR**		Connects a Form A (normally open) contact in parallel.	1 (2)
OR Not	**OR/**		Connects a Form B (normally closed) contact in parallel.	1 (2)
Alternative out	**ALT**		Inverts the output condition (on/off) each time the leading edge of the trigger is detected.	3
AND stack	**ANS**		Connects the multiple instruction blocks serially.	1
OR stack	**ORS**		Connects the multiple instruction blocks in parallel.	1
Push stack	**PSHS**		Stores the operated result up to this instruction.	1
Read stack	**RDS**		Reads the operated result stored by the **PSHS** instruction.	1
Pop stack	**POPS**		Reads and clears the operated result stored by the **PSHS** instruction.	1
Leading edge differential	**DF**		Turns on the contact for only one scan when the leading edge of the trigger is detected.	1
Trailing edge differential	**DF/**		Turns on the contact for only one scan when the trailing edge of the trigger is detected.	1

Note

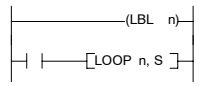
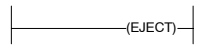
When T256/C256 and higher or R9000 and higher are used, the number of steps is indicated in parentheses.

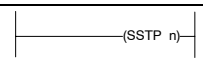
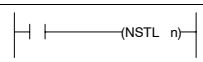
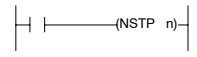
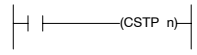
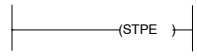
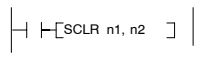
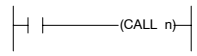
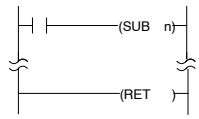
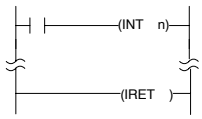
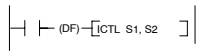
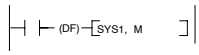
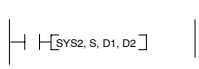
Name	Boolean	Symbol	Description	Steps
Leading edge differential (initial execution type)	**DFI**		Turns on the contact for only one scan when the leading edge of the trigger is detected. The leading edge detection is possible on the first scan.	1
Set	**SET**		Output is set to and held at on.	3
Reset	**RST**		Output is set to and held at off.	3
Keep	**KP**		Outputs at set trigger and holds until reset trigger turns on.	1
No operation	**NOP**		No operation.	1

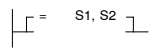
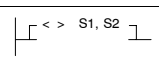
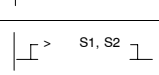
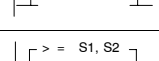
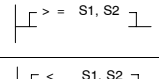
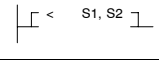
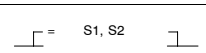
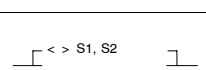
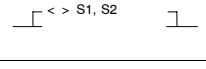
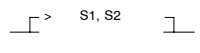
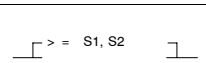
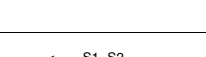
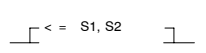
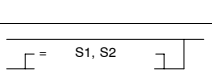
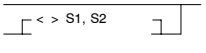
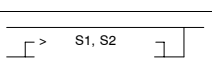
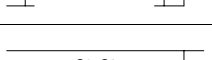
Name	Boolean	Symbol	Description	Steps
Basic function instructions				
On-delay timer	**TML**		After set value “n” × 0.001 seconds, timer contact “a” is set to on.	3 (4)
	TMR		After set value “n” × 0.01 seconds, timer contact “a” is set to on.	3 (4)
	TMX		After set value “n” × 0.1 seconds, timer contact “a” is set to on.	3 (4)
	TMY		After set value “n” × 1 second, timer contact “a” is set to on.	4 (5)
Auxiliary timer (16–bit)	**F137 (STMR)**		After set value “S” × 0.01 seconds, the specified output and R900D are set to on.	5
Auxiliary timer (32–bit)	**F183 (DSTM)**		After set value “S” × 0.01 seconds, the specified output and R900D are set to on.	7
Counter	**CT**		Decrements from the preset value “n”.	3 (4)
UP/DOWN counter	**F118 (UDC)**		Increments or decrements from the preset value “S” based on up/down input.	5
Shift register	**SR**		Shifts one bit of 16-bit [word internal relay (WR)] data to the left.	1
Left/right shift register	**F119 (LRSR)**		Shifts one bit of 16-bit data range specified by “D1” and “D2” to the left or to the right.	5
Control instructions				
Master control relay	**MC**		Starts the master control program.	2
Master control relay end	**MCE**		Ends the master control program.	2
Jump	**JP**		The program jumps to the label instruction and continues from there.	2
Label	**LBL**			1

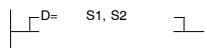
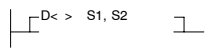
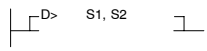
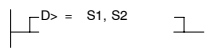
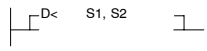
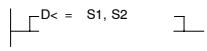
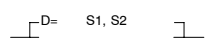
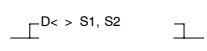
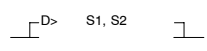
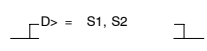
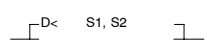
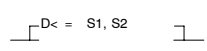
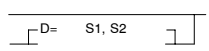
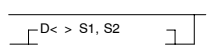
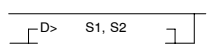
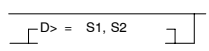
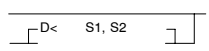
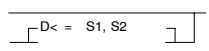
Note

When T256/C256 and higher or R9000 and higher are used, the number of steps is indicated in parentheses.

Name	Boolean	Symbol	Description	Steps
Loop	**LOOP**		The program jumps to the label instruction and continues from there (the number of jumps is set in “S”).	4
Label	**LBL**			1
End	**ED**		The operation of program is ended. Indicates the end of a main program.	1
Conditional end	**CNDE**		The operation of program is ended when the trigger turns on.	1
Eject	**EJECT**		Adds page break for use when printing.	1

Name	Boolean	Symbol	Description	Steps
Step ladder instructions				
Start step	**SSTP**		The start of program “n” for process control	3
Next step	**NSTL**		Start the specified process “n” and clear the process currently operated. (Scan execution type)	3
	NSTP		Start the specified process “n” and clear the process currently operated. (Pulse execution type)	3
Clear step	**CSTP**		Resets the currently operated process “n”.	3
Step end	**STPE**		End of step ladder area	1
Clear multiple steps	**SCLR**		Resets the currently operated processes “n1” to “n2”.	5
Subroutine instructions				
Subroutine call	**CALL**		Executes the specified subroutine. When returning to the main program, outputs in the subroutine program are maintained.	2
Subroutine entry	**SUB**		Indicates the start of the subroutine program “n”.	1
Subroutine return	**RET**		Ends the subroutine program.	1
Interrupt instructions				
Interrupt	**INT**		Indicates the start of the interrupt program “n”.	1
Interrupt return	**IRET**		Ends the interrupt program.	1
Interrupt control	**ICTL**		Select interrupt enable/disable or clear in “S1” and “S2” and execute.	5
Special setting instructions				
Communication conditions setting	**SYS1**		Change the communication conditions for the COM port or tool port based on the contents specified by the character constant.	13
Password setting			Change the password specified by the PLC based on the contents specified by the character constant.	
Interrupt setting			Set the interrupt input based on the contents specified by the character constant.	
PLC link time setting			Set the system setting time when a PLC link is used, based on the contents specified by the character constant.	
RS485 response time control			Change the communication conditions of the COM. port or tool port for RS485 based on the contents specified by the character constant.	
System registers “No. 40 to No. 47” changing	**SYS2**		Change the setting value of the system register for the PLC link function.	7

Name	Boolean	Symbol	Description	Steps
Data comparison instructions				
16-bit data comparison (Start)	**ST=**		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	ST<>		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1 ≠ S2”.	5
	ST>		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	ST>=		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1 ≧ S2”.	5
	ST<		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	ST<=		Begins a logic operation by comparing two 16-bit data in the comparative condition “S1≦ S2”.	5
16-bit data comparison (AND)	**AN=**		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	AN<>		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1 ≠ S2”.	5
	AN>		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	AN>=		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1 ≧ S2”.	5
	AN<		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	AN<=		Connects a contact serially by comparing two 16-bit data in the comparative condition “S1 ≦ S2”.	5
16-bit data comparison (OR)	**OR=**		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1=S2”.	5
	OR<>		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1 ≠ S2”.	5
	OR>		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1>S2”.	5
	OR>=		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1 ≧ S2”.	5
	OR<		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1<S2”.	5
	OR<=		Connects a contact in parallel by comparing two 16-bit data in the comparative condition “S1 ≦ S2”.	5

Name	Boolean	Symbol	Description	Steps
32-bit data comparison (Start)	**STD=**		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) = (S2+1, S2)”.	9
	STD<>		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≠ (S2+1, S2)”.	9
	STD>		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) > (S2+1, S2)”.	9
	STD>=		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≧ (S2+1, S2)”.	9
	STD<		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) < (S2+1, S2)”.	9
	STD<=		Begins a logic operation by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≦ (S2+1, S2)”.	9
32-bit data comparison (AND)	**AND=**		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	AND<>		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≠(S2+1, S2)”.	9
	AND>		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	AND>=		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≧(S2+1, S2)”.	9
	AND<		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	AND<=		Connects a contact serially by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≦(S2+1, S2)”.	9
32-bit data comparison (OR)	**ORD=**		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)=(S2+1, S2)”.	9
	ORD<>		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≠ (S2+1, S2)”.	9
	ORD>		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)>(S2+1, S2)”.	9
	ORD>=		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≧ (S2+1, S2)”.	9
	ORD<		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1)<(S2+1, S2)”.	9
	ORD<=		Connects a contact in parallel by comparing two 32-bit data in the comparative condition “(S1+1, S1) ≦(S2+1, S2)”.	9

B.7.2 Table of High–Level Instructions

No.	Name	Boolean	Operand	Description	Steps
Data transfer instructions					
F0	**16-bit data move**	**MV**	S, D	(S) → (D)	5
F1	**32-bit data move**	**DMV**	S, D	(S+1, S) → (D+1, D)	7
F2	**16-bit data invert and move**	**MV/**	S, D	($\overline{S}$) → (D)	5
F3	**32-bit data invert and move**	**DMV/**	S, D	($\overline{S+1, S}$) → (D+1, D)	7
F5	**Bit data move**	**BTM**	S, n, D	The specified one bit in “S” is transferred to the specified one bit in “D”. The bit is specified by “n”.	7
F6	**Hexadecimal digit (4-bit) data move**	**DGT**	S, n, D	The specified one digit in “S” is transferred to the specified one digit in “D”. The digit is specified by “n”.	7
F7	**Two 16-bit data move**	**MV2**	S1, S2, D	(S1) → (D), (S2) → (D+1)	7
F8	**Two 32-bit data move**	**DMV2**	S1, S2, D	(S1+1, S1) → (D+1, D), (S2+1, S2) → (D+3, D+2)	11
F10	**Block move**	**BKMV**	S1, S2, D	The data between “S1” and “S2” is transferred to the area starting at “D”.	7
F11	**Block copy**	**COPY**	S, D1, D2	The data of “S” is transferred to the all area between “D1” and “D2”.	7
F12	**Data read from F–ROM**	**ICRD**	S1, S2, D	The data stored in the F–ROM specified by “S1” and “S2” are transferred to the area starting at “D”.	11
P13	**Data write to F–ROM**	**PICWT**	S1, S2, D	The data specified by “S1” and “S2” are transferred to the F–ROM starting at “D”.	11
F15	**16-bit data exchange**	**XCH**	D1, D2	(D1) → (D2), (D2) → (D1)	5
F16	**32-bit data exchange**	**DXCH**	D1, D2	(D1+1, D1) → (D2+1, D2) (D2+1, D2) → (D1+1, D1)	5
F17	**Higher/ lower byte in 16-bit data exchange**	**SWAP**	D	The higher byte and lower byte of “D” are exchanged.	3
F18	**16-bit data block exchange**	**BXCH**	D1, D2, D3	Exchange the data between “D1” and “D2” with the data specified by “D3”.	7

No.	Name	Boolean	Operand	Description	Steps
Binary arithmetic instructions					
F20	**16-bit data addition**	**+**	S, D	(D) + (S) → (D)	5
F21	**32-bit data addition**	**D+**	S, D	(D +1, D) + (S+1, S) → (D+1, D)	7
F22	**16-bit data addition (Destination setting)**	**+**	S1, S2, D	(S1) + (S2) → (D)	7
F23	**32-bit data addition (Destination setting)**	**D+**	S1, S2, D	(S1+1, S1) + (S2+1, S2) → (D+1, D)	11
F25	**16-bit data subtraction**	**–**	S, D	(D) – (S) → (D)	5
F26	**32-bit data subtraction**	**D–**	S, D	(D+1, D) – (S+1, S) → (D+1, D)	7
F27	**16-bit data subtraction (Destination setting)**	**–**	S1, S2, D	(S1) – (S2) → (D)	7
F28	**32-bit data subtraction (Destination setting)**	**D–**	S1, S2, D	(S1+1, S1) – (S2+1, S2) → (D+1, D)	11
F30	**16-bit data multiplication**	*****	S1, S2, D	(S1) × (S2) → (D+1, D)	7
F31	**32-bit data multiplication**	**D***	S1, S2, D	(S1+1, S1) × (S2+1, S2) → (D+3, D+2, D+1, D)	11
F32	**16-bit data division**	**%**	S1, S2, D	(S1) ÷ (S2) → quotient (D) remainder (DT90015)	7
F33	**32-bit data division**	**D%**	S1, S2, D	(S1+1, S1) ÷ (S2+1, S2) → quotient (D+1, D) remainder (DT90016, DT90015)	11
F34	**16-bit data multiplication (result in one word)**	***W**	S1, S2, D	(S1) × (S2) → (D)	7
F35	**16-bit data increment**	**+1**	D	(D) + 1 → (D)	3
F36	**32-bit data increment**	**D+1**	D	(D+1, D) + 1 → (D+1, D)	3
F37	**16-bit data decrement**	**–1**	D	(D) – 1 → (D)	3
F38	**32-bit data decrement**	**D–1**	D	(D+1, D) – 1 → (D+1, D)	3
F39	**32-bit data multiplication (result in two words)**	**D*D**	S1, S2, D	(S1+1, S1) × (S2+1, S2) → (D+1, D)	11

No.	Name	Boolean	Operand	Description	Steps
BCD arithmetic instructions					
F40	**4-digit BCD data addition**	**B+**	S, D	(D) + (S) → (D)	5
F41	**8-digit BCD data addition**	**DB+**	S, D	(D+1, D) + (S+1, S) → (D+1, D)	7
F42	**4-digit BCD data addition (Destination setting)**	**B+**	S1, S2, D	(S1) + (S2) → (D)	7
F43	**8-digit BCD data addition (Destination setting)**	**DB+**	S1, S2, D	(S1+1, S1) + (S2+1, S2) → (D+1, D)	11
F45	**4-digit BCD data subtraction**	**B–**	S, D	(D) – (S) → (D)	5
F46	**8-digit BCD data subtraction**	**DB–**	S, D	(D+1, D) – (S+1, S) → (D+1, D)	7
F47	**4-digit BCD data subtraction (Destination setting)**	**B–**	S1, S2, D	(S1) – (S2) → (D)	7
F48	**8-digit BCD data subtraction (Destination setting)**	**DB–**	S1, S2, D	(S1+1, S1) – (S2+1, S2) → (D+1, D)	11
F50	**4-digit BCD data multiplication**	**B***	S1, S2, D	(S1) × (S2) → (D+1, D)	7
F51	**8-digit BCD data multiplication**	**DB***	S1, S2, D	(S1+1, S1) × (S2+1, S2) → (D+3, D+2, D+1, D)	11
F52	**4-digit BCD data division**	**B%**	S1, S2, D	(S1) ÷ (S2) → quotient (D) remainder (DT90015)	7
F53	**8-digit BCD data division**	**DB%**	S1, S2, D	(S1+1, S1) ÷ (S2+1, S2) → quotient (D+1, D) remainder (DT90016, DT90015)	11
F55	**4-digit BCD data increment**	**B+1**	D	(D) + 1 → (D)	3
F56	**8-digit BCD data increment**	**DB+1**	D	(D+1, D) + 1 → (D+1, D)	3
F57	**4-digit BCD data decrement**	**B–1**	D	(D) – 1 → (D)	3
F58	**8-digit BCD data decrement**	**DB–1**	D	(D+1, D) – 1 → (D+1, D)	3
Data comparison instructions					
F60	**16-bit data comparison**	**CMP**	S1, S2	(S1) > (S2) → R900A: on (S1) = (S2) → R900B: on (S1) < (S2) → R900C: on	5
F61	**32-bit data comparison**	**DCMP**	S1, S2	(S1+1, S1) > (S2+1, S2) → R900A: on (S1+1, S1) = (S2+1, S2) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	9
F62	**16-bit data band comparison**	**WIN**	S1, S2, S3	(S1) > (S3) → R900A: on (S2) ≦ (S1) ≦ (S3) → R900B: on (S1) < (S2) → R900C: on	7

No.	Name	Boolean	Operand	Description	Steps
F63	**32-bit data band comparison**	**DWIN**	S1, S2, S3	(S1+1, S1) > (S3+1, S3) → R900A: on (S2+1, S2) ≦ (S1+1, S1) ≦ (S3+1, S3) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	13
F64	**Block data comparison**	**BCMP**	S1, S2, S3	Compares the two blocks beginning with “S2” and “S3” to see if they are equal.	7
Logic operation instructions					
F65	**16-bit data AND**	**WAN**	S1, S2, D	(S1) ∧ (S2) → (D)	7
F66	**16-bit data OR**	**WOR**	S1, S2, D	(S1) ∨ (S2) → (D)	7
F67	**16-bit data exclusive OR**	**XOR**	S1, S2, D	{(S1) ∧ ($\overline{S2}$)} ∨ {($\overline{S1}$) ∧ (S2)} → (D)	7
F68	**16-bit data exclusive NOR**	**XNR**	S1, S2, D	{(S1) ∧ (S2)} ∨ {($\overline{S1}$) ∧ ($\overline{S2}$)} → (D)	7
F69	**Word (16-bit) data unite**	**WUNI**	S1, S2, S3, D	([S1] ∧ [S3]) ∨ ([S2] ∧ [$\overline{S3}$]) → (D) When (S3) is H0, (S2) → (D) When (S3) is HFFFF, (S1) → (D)	9
Data conversion instructions					
F70	**Block check code calculation**	**BCC**	S1, S2, S3, D	Creates the code for checking the data specified by “S2” and “S3” and stores it in “D”. The calculation method is specified by “S1”.	9
F71	**Hexadecimal data → ASCII code**	**HEXA**	S1, S2, D	Converts the hexadecimal data specified by “S1” and “S2” to ASCII code and stores it in “D”. Example: HABCD → H 42 41 44 43 B A D C	7
F72	**ASCII code → Hexadecimal data**	**AHEX**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to hexadecimal data and stores it in “D”. Example: H 44 43 42 41 → HCDAB D C B A	7
F73	**4-digit BCD data → ASCII code**	**BCDA**	S1, S2, D	Converts the four digits of BCD data specified by “S1” and “S2” to ASCII code and stores it in “D”. Example: H1234 → H 32 31 34 33 2 1 4 3	7
F74	**ASCII code → 4-digit BCD data**	**ABCD**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to four digits of BCD data and stores it in “D”. Example: H 34 33 32 31 → H3412 4 3 2 1	7
F75	**16-bit binary data → ASCII code**	**BINA**	S1, S2, D	Converts the 16 bits of binary data specified by “S1” to ASCII code and stores it in “D” (area of “S2” bytes). Example: K–100 → H 30 30 31 2D 20 20 0 0 1 –	7
F76	**ASCII code → 16-bit binary data**	**ABIN**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to 16 bits of binary data and stores it in “D”. Example: H 30 30 31 2D 20 20 → K–100 0 0 1 –	7
F77	**32-bit binary data → ASCII code**	**DBIA**	S1, S2, D	Converts the 32 bits of binary data (S1+1, S1) to ASCII code and stores it in (D+1, D).	11
F78	**ASCII code → 32-bit binary data**	**DABI**	S1, S2, D	Converts the ASCII code specified by “S1” and “S2” to 32 bits of binary data and stores it in (D+1, D).	11

No.	Name	Boolean	Operand	Description	Steps
F80	**16-bit binary data → 4-digit BCD data**	**BCD**	S, D	Converts the 16 bits of binary data specified by “S” to four digits of BCD data and stores it in “D”. Example: K100 → H100	5
F81	**4-digit BCD data → 16-bit binary data**	**BIN**	S, D	Converts the four digits of BCD data specified by “S” to 16 bits of binary data and stores it in “D”. Example: H100 → K100	5
F82	**32-bit binary data → 8-digit BCD data**	**DBCD**	S, D	Converts the 32 bits of binary data specified by (S+1, S) to eight digits of BCD data and stores it in (D+1, D).	7
F83	**8-digit BCD data → 32-bit binary data**	**DBIN**	S, D	Converts the eight digits of BCD data specified by (S+1, S) to 32 bits of binary data and stores it in (D+1, D).	7
F84	**16-bit data invert**	**INV**	D	Inverts each bit of data of “D”.	3
F85	**16-bit data complement of 2**	**NEG**	D	Inverts each bit of data of “D” and adds 1 (inverts the sign).	3
F86	**32-bit data complement of 2**	**DNEG**	D	Inverts each bit of data of (D+1, D) and adds 1 (inverts the sign).	3
F87	**16-bit data absolute**	**ABS**	D	Gives the absolute value of the data of “D”.	3
F88	**32-bit data absolute**	**DABS**	D	Gives the absolute value of the data of (D+1, D).	3
F89	**16-bit data sign extension**	**EXT**	D	Extends the 16 bits of data in “D” to 32 bits in (D+1, D).	3
F90	**Decode**	**DECO**	S, n, D	Decodes part of the data of “S” and stores it in “D”. The part is specified by “n”.	7
F91	**7-segment decode**	**SEGT**	S, D	Converts the data of “S” for use in a 7-segment display and stores it in (D+1, D).	5
F92	**Encode**	**ENCO**	S, n, D	Encodes part of the data of “S” and stores it in “D”. The part is specified by “n”.	7
F93	**16-bit data digit combine**	**UNIT**	S, n, D	The least significant digit of each of the “n” words of data beginning at “S” are stored (united) in order in “D”.	7
F94	**16-bit data digit distribute**	**DIST**	S, n, D	Each of the digits of the data of “S” are stored in (distributed to) the least significant digits of the areas beginning at “D”.	7
F95	**ASCII code conversion**	**ASC**	S, D	Twelve characters of the character constants of “S” are converted to ASCII code and stored in “D” to “D+5”.	15
F96	**16-bit table data search**	**SRC**	S1, S2, S3	The data of “S1” is searched for in the areas in the range “S2” to “S3” and the result is stored in DT90037 and DT90038.	7
F97	**32-bit table data search**	**DSRC**	S1, S2, S3	The data of (S1+1, S1) is searched for in the 32-bit data designated by “S3”, beginning from “S2”, and the result is stored in DT90037 and DT90038.	9

No.	Name	Boolean	Operand	Description	Steps
Data shift instructions					
F98	**Data table shift-out and compress**	**CMPR**	D1, D2, D3	Transfer “D2” to “D3”. Any parts of the data between “D1” and “D2” that are 0 are compressed, and shifted in order toward “D2”.	7
F99	**Data table shift-in and compress**	**CMPW**	S, D1, D2	Transfer “S” to “D1”. Any parts of the data between “D1” and “D2” that are 0 are compressed, and shifted in order toward “D2”.	7
F100	**Right shift of n bits in a 16-bit data**	**SHR**	D, n	Shifts the “n” bits of “D” to the right.	5
F101	**Left shift of n bits in a 16-bit data**	**SHL**	D, n	Shifts the “n” bits of “D” to the left.	5
F102	**Right shift of n bits in a 32-bit data**	**DSHR**	D, n	Shifts the “n” bits of the 32-bit data area specified by (D+1, D) to the right.	5
F103	**Left shift of n bits in a 32-bit data**	**DSHL**	D, n	Shifts the “n” bits of the 32-bit data area specified by (D+1, D) to the left.	5
F105	**Right shift of one hexadecimal digit (4-bit)**	**BSR**	D	Shifts the one digit of data of “D” to the right.	3
F106	**Left shift of one hexadecimal digit (4-bit)**	**BSL**	D	Shifts the one digit of data of “D” to the left.	3
F108	**Right shift of multiple bits (n bits)**	**BITR**	D1, D2, n	Shifts the “n” bits of data range by “D1” and “D2” to the right.	7
F109	**Left shift of multiple bits (n bits)**	**BITL**	D1, D2, n	Shifts the “n” bits of data range by “D1” and “D2” to the left.	7
F110	**Right shift of one word (16-bit)**	**WSHR**	D1, D2	Shifts the one word of the areas by “D1” and “D2” to the right.	5
F111	**Left shift of one word (16-bit)**	**WSHL**	D1, D2	Shifts the one word of the areas by “D1” and “D2” to the left.	5
F112	**Right shift of one hexadecimal digit (4-bit)**	**WBSR**	D1, D2	Shifts the one digit of the areas by “D1” and “D2” to the right.	5
F113	**Left shift of one hexadecimal digit (4-bit)**	**WBSL**	D1, D2	Shifts the one digit of the areas by “D1” and “D2” to the left.	5
Data buffer instructions					
F115	**FIFO buffer define**	**FIFT**	n, D	The “n” words beginning from “D” are defined in the buffer.	5
F116	**Data read from FIFO buffer**	**FIFR**	S, D	The oldest data beginning from “S” that was written to the buffer is read and stored in “D”.	5
F117	**Data write into FIFO buffer**	**FIFW**	S, D	The data of “S” is written to the buffer starting from “D”.	5

No.	Name	Boolean	Operand	Description	Steps
Basic function instructions					
F118	**UP/DOWN counter**	**UDC**	S, D	Counts up or down from the value preset in “S” and stores the elapsed value in “D”.	5
F119	**Left/right shift register**	**LRSR**	D1, D2	Shifts one bit to the left or right with the area between “D1” and “D2” as the register.	5
Data rotation instructions					
F120	**16-bit data right rotation**	**ROR**	D, n	Rotate the “n” bits in data of “D” to the right.	5
F121	**16-bit data left rotation**	**ROL**	D, n	Rotate the “n” bits in data of “D” to the left.	5
F122	**16-bit data right rotation with carry flag data**	**RCR**	D, n	Rotate the “n” bits in 17-bit area consisting of “D” plus the carry flag (R9009) data to the right.	5
F123	**16-bit data left rotation with carry flag data**	**RCL**	D, n	Rotate the “n” bits in 17-bit area consisting of “D” plus the carry flag (R9009) data to the left.	5
F125	**32-bit data right rotation**	**DROR**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the right.	5
F126	**32-bit data left rotation**	**DROL**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the left.	5
F127	**32-bit data right rotation with carry flag data**	**DRCR**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the right together with carry flag (R9009) data.	5
F128	**32-bit data left rotation with carry flag data**	**DRCL**	D, n	Rotate the number of bits specified by “n” of the double words data (32 bits) specified by (D+1, D) to the left together with carry flag (R9009) data.	5
Bit manipulation instructions					
F130	**16-bit data bit set**	**BTS**	D, n	Set the value of bit position “n” of the data of “D” to 1.	5
F131	**16-bit data bit reset**	**BTR**	D, n	Set the value of bit position “n” of the data of “D” to 0.	5
F132	**16-bit data bit invert**	**BTI**	D, n	Invert the value of bit position “n” of the data of “D”.	5
F133	**16-bit data bit test**	**BTT**	D, n	Test the value of bit position “n” of the data of “D” and output the result to R900B.	5
F135	**Number of on (1) bits in 16-bit data**	**BCU**	S, D	Store the number of on (1) bits in the data of “S” in “D”.	5
F136	**Number of on (1) bits in 32-bit data**	**DBCU**	S, D	Store the number of on (1) bits in the data of (S+1, S) in “D”.	7
Basic function instruction					
F137	**Auxiliary timer (16–bit)**	**STMR**	S, D	Turn on the specified output and R900D after set value “S” × 0.01 sec..	5

No.	Name	Boolean	Operand	Description	Steps
Special instructions					
F138	**Hours, minutes and seconds data to seconds data**	**HMSS**	S, D	Converts the hour, minute and second data of (S+1, S) to seconds data, and the converted data is stored in (D+1, D).	5
F139	**Seconds data to hours, minutes and seconds data**	**SHMS**	S, D	Converts the seconds data of (S+1, S) to hour, minute and second data, and the converted data is stored in (D+1, D).	5
F140	**Carry flag set**	**STC**	——	Turns on the carry flag (R9009).	1
F141	**Carry flag reset**	**CLC**	——	Turns off the carry flag (R9009).	1
F143	**Partial I/O update**	**IORF**	D1, D2	Updates the I/O from the number specified by “D1” to the number specified by “D2”. Only possible for I/O numbers in a range of X0 to XF and Y0 to YF.	5
F147	**Printout**	**PR**	S, D	Converts the ASCII code data in the area starting with “S” for printing, and outputs it to the word external output relay WY specified by “D”.	5
F148	**Self-diagnostic error set**	**ERR**	n (n: K100 to K299)	Stores the self-diagnostic error number “n” in DT90000 turns R9000 on, and turns on the ERROR/ALARM LED.	3
F149	**Message display**	**MSG**	S	Displays the character constant of “S” in the connected programming tool.	13
F150	**Read data**	**READ**	S1, S2, n, D	Reads “n” words of data from the shared memory address ”S2” of the intelligent unit with the slot number specified as ”S1”, and reads to the address starting at “D”.	9
F151	**Write data**	**WRT**	S1, S2, n, D	Reads ”n” words of data from area specified by ”S2”, and writes it to the address starting at ”D” of the intelligent unit with the slot number specified as ”S1”.	9
F157	**Time addition**	**CADD**	S1, S2, D	The time after (S2+1, S2) elapses from the time of (S1+2, S1+1, S1) is stored in (D+2, D+1, D).	9
F158	**Time substruction**	**CSUB**	S1, S2, D	The time that results from subtracting (S2+1, S2) from the time (S1+2, S1+1, S1) is stored in (D+2, D+1, D).	9
F159	**Serial data communication**	**MTRN**	S, n, D	This is used to send data to or receive data from an external device through the specified COM., RS232C or RS485 port.	7

No.	Name	Boolean	Operand	Description	Steps
BIN arithmetic instruction					
F160	**Double word (32-bit) data square root**	**DSQR**	S, D	$\sqrt{(S)} \rightarrow (D)$	7
High–speed counter and pulse output control instructions					
F0	**High–speed counter and pulse output control**	**MV**	S, DT90052	Performs high–speed counter control according to the control code specified by “S”.	5
F1	**Change and read of the elapsed value of high–speed counter**	**DMV**	S, DT90044	Transfers (S+1, S) to high–speed counter elapsed value area (DT90045, DT90044). See note.	7
			DT90044, D	Transfers value in high–speed counter elapsed value area (DT90045, DT90044) to (D+1, D). See note.	7
F166	**Target value much on (with channel specification)**	**HC1S**	n, S, D	Turns output Yn on when the elapsed value of the built–in high–speed counter reaches the target value of (S+1,S).	11
F167	**Target value much off (with channel specification)**	**HC1R**	n, S, D	Turns output Yn off when the elapsed value of the built–in high–speed counter reaches the target value of (S+1,S).	11
F171	**Pulse output (with channel specification) (Trapezoidal control and home return)**	**SPDH**	S, n	Positioning pulses are output from the specified channel, in accordance with the contents of the data table that starts with S.	5
F172	**Pulse output (with channel specification) (JOG operation)**	**PLSH**	S, n	Pulse strings are output from the specified output, in accordance with the contents of the data table that starts with S.	5
F173	**PWM output (with channel specification)**	**PWMH**	S, n	PWM output is output from the specified output, in accordance with the contents of the data table that starts with S.	5
F174	**Pulse output (with channel specification) (Selectable data table control operation)**	**SP0H**	S, n	Outputs the pulses from the specified channel according to the data table specified by S.	5
F175	**Pulse output (Linear interpolation)**	**SPSH**	S, n	Pulses are output from channel, in accordance with the designated data table, so that the path to the target position forms a straight line.	5
F176	**Pulse output (Arc interpolation)**	**SPCH**	S, n	Pulses are output from channel, in accordance with the designated data table, so that the path to the target position forms an arc.	5

Note

The elapsed value area varies depending on the channel being used.

No.	Name	Boolean	Operand	Description	Steps
Basic function instruction					
F183	**Auxiliary timer (32-bit)**	**DSTM**	S, D	Turn on the specified output and R900D after set value "S" × 0.01 sec..	7
Data transfer instructions					
F190	**Three 16-bit data move**	**MV3**	S1, S2, S3, D	(S1) → (D), (S2) → (D+1), (S3) → (D+2)	10
F191	**Three 32-bit data move**	**DMV3**	S1, S2, S3, D	(S1+1, S1) → (D+1, D), (S2+1, S2) → (D+3, D+2), (S3+1, S3) → (D+5, D+4)	16
Logic operation instructions					
F215	**32-bit data AND**	**DAND**	S1, S2, D	(S1+1, S1) ∧ (S2+1, S2) → (D+1, D)	12
F216	**32-bit data OR**	**DOR**	S1, S2, D	(S1+1, S1) ∨ (S2+1, S2) → (D+1, D)	12
F217	**32-bit data XOR**	**DXOR**	S1, S2, D	{(S1+1, S1) ∧ $\overline{(S2+1, S2)}$} ∨{$\overline{(S1+1, S1)}$ ∧(S2+1, S2)} → (D+1, D)	12
F218	**32-bit data XNR**	**DXNR**	S1, S2, D	{(S1+1, S1) ∧ (S2+1, S2)} ∨{$\overline{(S1+1, S1)}$ ∧$\overline{(S2+1, S2)}$} → (D+1, D)	12
F219	**Double word (32-bit) data unites**	**DUNI**	S1, S2, S3, D	{(S1+1, S1) ∧ (S3+1, S3)} ∨ {(S2+1, S2) ∧ $\overline{(S3+1, S3)}$} → (D+1, D)	16
Data conversion instructions					
F235	**16–bit binary data → Gray code conversion**	**GRY**	S, D	Converts the 16-bit binary data of "S" to gray codes, and the converted result is stored in the "D".	6
F236	**32–bit binary data → Gray code conversion**	**DGRY**	S, D	Converts the 32-bit binary data of (S+1, S) to gray code, and the converted result is stored in the (D+1, D).	8
F237	**16–bit gray code → binary data conversion**	**GBIN**	S, D	Converts the gray codes of "S" to binary data, and the converted result is stored in the "D".	6

No.	Name	Boolean	Operand	Description	Steps
F238	**32–bit gray code → binary data conversion**	**DGBIN**	S, D	Converts the gray code of (S+1, S) to binary data,and the converted result is stored in the (D+1, D).	8
F240	**Bit line to bit column conversion**	**COLM**	S, n, D	The values of bits line 0 to 15 of “S” are stored in bit column “n” of (D to D+15).	8
F241	**Bit column to bit line conversion**	**LINE**	S, n, D	The values of bit column “n” of (S to S+15) are stored in bits line 0 to 15 of “D”.	8
Character strings instructions					
F257	**Comparing character strings**	**SCMP**	S1, S2	These instructions compare two specified character strings and output the judgment results to a special internal relay.	10
F258	**Character string coupling**	**SADD**	S1, S2, D	These instructions couple one character string with another.	12
F259	**Number of characters in a character string**	**LEN**	S, D	These instructions determine the number of characters in a character string.	6
F260	**Search for character string**	**SSRC**	S1, S2, D	The specified character is searched in a character string.	10
F261	**Retrieving data from character strings (right side)**	**RIGHT**	S1, S2, D	These instructions retrieve a specified number of characters from the right side of the character string.	8
F262	**Retrieving data from character strings (left side)**	**LEFT**	S1, S2, D	These instructions retrieve a specified number of characters from the left side of the character string.	8
F263	**Retrieving a character string from a character string**	**MIDR**	S1, S2, S3, D	These instructions retrieve a character string consisting of a specified number of characters from the specified position in the character string.	10
F264	**Writing a character string to a character string**	**MIDW**	S1, S2, D, n	These instructions write a specified number of characters from a character string to a specified position in the character string.	12
F265	**Replacing character strings**	**SREP**	S, D, p, n	A specified number of characters in a character string are rewritten, starting from a specified position in the character string.	12

No.	Name	Boolean	Operand	Description	Steps
Integer type data processing instructions					
F270	**Maximum value (word data (16-bit))**	**MAX**	S1, S2, D	Searches the maximum value in the word data table between the “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+1”.	8
F271	**Maximum value (double word data (32-bit))**	**DMAX**	S1, S2, D	Searches for the maximum value in the double word data table between the area selected with “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+2”.	8
F272	**Minimum value (word data (16-bit))**	**MIN**	S1, S2, D	Searches for the minimum value in the word data table between the area selected with “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+1”.	8
F273	**Minimum value (double word data (32-bit))**	**DMIN**	S1, S2, D	Searches for the minimum value in the double word data table between the area selected with “S1” and “S2”, and stores it in the “D”. The address relative to “S1” is stored in “D+2”.	8
F275	**Total and mean values (word data (16-bit))**	**MEAN**	S1, S2, D	The total value and the mean value of the word data with sign from the area selected with “S1” to the “S2” are stored in the “D”.	8
F276	**Total and mean values (double word data (32-bit))**	**DMEAN**	S1, S2, D	The total value and the mean value of the double word data with sign from the area selected with “S1” to “S2” are stored in the “D”.	8
F277	**Sort (word data (16-bit))**	**SORT**	S1, S2, S3	The word data with sign from the area specified by “S1” to “S2” are sorted in ascending order (the smallest word is first) or descending order (the largest word is first).	8
F278	**Sort (double word data (32-bit))**	**DSORT**	S1, S2, S3	The double word data with sign from the area specified by “S1” to “S2” are sorted in ascending order (the smallest word is first) or descending order (the largest word is first).	8
F282	**Scaling of 16–bit data**	**SCAL**	S1, S2, D	The output value “Y” is found for the input value “X” by performing scaling for the given data table.	8
F283	**Scaling of 32–bit data**	**DSCAL**	S1, S2, D	The output value “Y” is found for the input value “X” by performing scaling for the given data table.	10
F285	**16-bit data upper and lower limit control**	**LIMT**	S1, S2, S3, D	When S1 > S3, S1 → D When S2 < S3, S2 → D When S1 ≦ S3 ≦ S2, S3 → D	10
F286	**32-bit data upper and lower limit control**	**DLIMT**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), (S3+1, S3) → (D+1, D)	16
F287	**16-bit data deadband control**	**BAND**	S1, S2, S3, D	When S1 > S3, S3 – S1 → D When S2 < S3, S3 – S2 → D When S1 ≦ S3 ≦ S2, 0 → D	10
F288	**32-bit data deadband control**	**DBAND**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S3+1, S3) – (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S3+1, S3) – (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), 0 → (D+1, D)	16

No.	Name	Boolean	Operand	Description	Steps
Integer type data processing instructions					
F289	**16-bit data zone control**	**ZONE**	S1, S2, S3, D	When S3 < 0, S3 + S1 → D When S3 = 0, 0 → D When S3 > 0, S3 + S2 → D	10
F290	**32-bit data zone control**	**DZONE**	S1, S2, S3, D	When (S3+1, S3) < 0, (S3+1, S3) + (S1+1, S1) → (D+1, D) When (S3+1, S3) = 0, 0 → (D+1, D) When (S3+1, S3) > 0, (S3+1, S3) + (S2+1, S2) → (D+1, D)	16
Floating-point type real number operation instructions					
F309	**Floating-point type data move**	**FMV**	S, D	(S+1, S) → (D+1, D)	8
F310	**Floating-point type data addition**	**F+**	S1, S2, D	(S1+1, S1) + (S2+1, S2) →(D+1, D)	14
F311	**Floating-point type data subtraction**	**F–**	S1, S2, D	(S1+1, S1) – (S2+1, S2) → (D+1, D)	14
F312	**Floating-point type data multiplication**	**F***	S1, S2, D	(S1+1, S1) × (S2+1, S2)□→(D+1, D)	14
F313	**Floating-point type data division**	**F%**	S1, S2, D	(S1+1, S1) ÷ (S2+1, S2) → (D+1, D)	14
F314	**Floating-point type data sine operation**	**SIN**	S, D	SIN (S+1, S) → (D+1, D)	10
F315	**Floating-point type data co-sine operation**	**COS**	S, D	COS (S+1, S) → (D+1, D)	10
F316	**Floating-point type datatang-ent operation**	**TAN**	S, D	TAN (S+1, S) → (D+1, D)	10
F317	**Floating-point type data arc-sine operation**	**ASIN**	S, D	SIN^{-1} (S+1, S) → (D+1, D)	10
F318	**Floating-point type data arccosine operation**	**ACOS**	S, D	COS^{-1} (S+1, S) → (D+1, D)	10
F319	**Floating-point type data arctangent operation**	**ATAN**	S, D	TAN^{-1} (S+1, S) → (D+1, D)	10
F320	**Floating-point type data natu-ral logarithm**	**LN**	S, D	LN (S+1, S) → (D+1, D)	10
F321	**Floating-point type data exponent**	**EXP**	S, D	EXP (S+1, S) → (D+1, D)	10

No.	Name	Boolean	Operand	Description	Steps
F322	**Floating-point type data logarithm**	**LOG**	S, D	LOG (S+1, S) → (D+1, D)	10
F323	**Floating-point type data power**	**PWR**	S1, S2, D	(S1+1, S1) ∧ (S2+1, S2) → (D+1, D)	14
F324	**Floating-point type data square root**	**FSQR**	S, D	$\sqrt{(S+1, S)}$ → (D+1, D)	10
F325	**16-bit integer data to floating-point type data conversion**	**FLT**	S, D	Converts the 16-bit integer data with sign specified by "S" to real number data, and the converted data is stored in "D".	6
F326	**32-bit integer data to floating-point type data conversion**	**DFLT**	S, D	Converts the 32-bit integer data with sign specified by (S+1, S) to real number data, and the converted data is stored in (D+1, D).	8
F327	**Floating-point type data to 16-bit integer conversion (the largest integer not exceeding the floating-point type data)**	**INT**	S, D	Converts real number data specified by (S+1, S) to the 16-bit integer data with sign (the largest integer not exceeding the floating-point data), and the converted data is stored in "D".	8
F328	**Floating-point type data to 32-bit integer conversion (the largest integer not exceeding the floating-point type data)**	**DINT**	S, D	Converts real number data specified by (S+1, S) to the 32-bit integer data with sign (the largest integer not exceeding the floating-point data), and the converted data is stored in (D+1, D).	8
F329	**Floating-point type data to 16-bit integer conversion (rounding the first decimal point down to integer)**	**FIX**	S, D	Converts real number data specified by (S+1, S) to the 16-bit integer data with sign (rounding the first decimal point down), and the converted data is stored in "D".	8
F330	**Floating-point type data to 32-bit integer conversion (rounding the first decimal point down to integer)**	**DFIX**	S, D	Converts real number data specified by (S+1, S) to the 32-bit integer data with sign (rounding the first decimal point down), and the converted data is stored in (D+1, D).	8

No.	Name	Boolean	Operand	Description	Steps
F331	**Floating-point type data to 16-bit integer conversion (rounding the first decimal point off to integer)**	**ROFF**	S, D	Converts real number data specified by (S+1, S) to the 16-bit integer data with sign (rounding the first decimal point off), and the converted data is stored in “D”.	8
F332	**Floating-point type data to 32-bit integer conversion (rounding the first decimal point off to integer)**	**DROFF**	S, D	Converts real number data specified by (S+1, S) to the 32-bit integer data with sign(rounding the first decimal point off), and the converted data is stored in (D+1, D).	8
F333	**Floating-point type data rounding the first decimal point down**	**FINT**	S, D	The decimal part of the real number data specified in (S+1, S) is rounded down, and the result is stored in (D+1, D).	8
F334	**Floating-point type data rounding the first decimal point off**	**FRINT**	S, D	The decimal part of the real number data stored in (S+1, S) is rounded off, and the result is stored in (D+1, D).	8
F335	**Floating-point type data sign changes**	**F+/–**	S, D	The real number data stored in (S+1, S) is changed the sign, and the result is stored in (D+1, D).	8
F336	**Floating-point type data absolute**	**FABS**	S, D	Takes the absolute value of real number data specified by (S+1, S), and the result (absolute value) is stored in (D+1, D).	8
F337	**Floating-point type data degree → radian**	**RAD**	S, D	The data in degrees of an angle specified in (S+1, S) is converted to radians (real number data), and the result is stored in (D+1, D).	8
F338	**Floating-point type data radian → degree**	**DEG**	S, D	The angle data in radians (real number data) specified in (S+1, S) is converted to angle data in degrees, and the result is stored in (D+1, D).	8

No.	Name	Boolean	Operand	Description	Steps
Floating-point type real number data processing instructions					
F345	**Floating-point type data compare**	**FCMP**	S1, S2	(S1+1, S1) > (S2+1, S2) → R900A: on (S1+1, S1) = (S2+1, S2) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	10
F346	**Floating-point type data band compare**	**FWIN**	S1, S2, S3	(S1+1, S1) > (S3+1, S3) → R900A: on (S2+1, S2) ≦ (S1+1, S1) ≦ (S3+1,S3) → R900B: on (S1+1, S1) < (S2+1, S2) → R900C: on	14
F347	**Floating-point type data upper and lower limit control**	**FLIMT**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), (S3+1, S3) → (D+1, D)	18
F348	**Floating-point type data dead-band control**	**FBAND**	S1, S2, S3, D	When (S1+1, S1) > (S3+1, S3), (S3+1, S3) − (S1+1, S1) → (D+1, D) When (S2+1, S2) < (S3+1, S3), (S3+1, S3) − (S2+1, S2) → (D+1, D) When (S1+1, S1) ≦ (S3+1, S3) ≦ (S2+1, S2), 0.0 → (D+1, D)	18
F349	**Floating-point type data zone control**	**FZONE**	S1, S2, S3, D	When (S3+1, S3) < 0.0, (S3+1, S3) + (S1+1, S1) → (D+1, D) When (S3+1, S3) = 0.0, 0.0 → (D+1, D) When (S3+1, S3) > 0.0, (S3+1, S3) + (S2+1, S2) → (D+1, D)	18
Process control instruction					
F355	**PID processing**	**PID**	S	PID processing is performed depending on the control value (mode and parameter) specified by (S to S+2) and (S+4 to S+10), and the result is stored in the (S+3).	4
Data compare instructions					
F373	**16-bit data revision detection**	**DTR**	S, D	If the data in the 16-bit area specified by “S” has changed since the previous execution, internal relay R9009 (carry flag) will turn on. “D” is used to store the data of the previous execution.	6
F374	**32-bit data revision detection**	**DDTR**	S, D	If the data in the 32-bit area specified by (S+1, S) has changed since the previous execution, internal relay R9009 (carry flag) will turn on. (D+1, D) is used to store the data of the previous execution.	6

B.8 MEWTOCOL–COM Communication Commands

Command name	Code	Description
Read contact area	RC (RCS) (RCP) (RCC)	Reads the on and off status of contacts. – Specifies only one point. – Specifies multiple contacts. – Specifies a range in word units.
Write contact area	WC (WCS) (WCP) (WCC)	Turns contacts on and off. – Specifies only one point. – Specifies multiple contacts. – Specifies a range in word units.
Read data area	RD	Reads the contents of a data area.
Write data area	WD	Writes data to a data area.
Read timer/counter set value area	RS	Reads the value set for a timer/counter.
Write timer/counter set value area	WS	Writes a timer/counter setting value.
Read timer/counter elapsed value area	RK	Reads the timer/counter elapsed value.
Write timer/counter elapsed value area	WK	Writes the timer/counter elapsed value.
Register or Reset contacts monitored	MC	Registers the contact to be monitored.
Register or Reset data monitored	MD	Registers the data to be monitored.
Monitoring start	MG	Monitors a registered contact or data.
Preset contact area (fill command)	SC	Embeds the area of a specified range in a 16–point on and off pattern.
Preset data area (fill command)	SD	Writes the same contents to the data area of a specified range.
Read system register	RR	Reads the contents of a system register.
Write system register	WR	Specifies the contents of a system register.
Read the status of PLC	RT	Reads the specifications of the programmable controller and error codes if an error occurs.
Remote control	RM	Switches the operation mode of the programmable controller.
Abort	AB	Aborts communication.

B.9 Hexadecimal/Binary/BCD

Decimal	Hexadecimal	Binary data	BCD data (Binary Coded Decimal)
0	0000	0000 0000 0000 0000	0000 0000 0000 0000
1	0001	0000 0000 0000 0001	0000 0000 0000 0001
2	0002	0000 0000 0000 0010	0000 0000 0000 0010
3	0003	0000 0000 0000 0011	0000 0000 0000 0011
4	0004	0000 0000 0000 0100	0000 0000 0000 0100
5	0005	0000 0000 0000 0101	0000 0000 0000 0101
6	0006	0000 0000 0000 0110	0000 0000 0000 0110
7	0007	0000 0000 0000 0111	0000 0000 0000 0111
8	0008	0000 0000 0000 1000	0000 0000 0000 1000
9	0009	0000 0000 0000 1001	0000 0000 0000 1001
10	000A	0000 0000 0000 1010	0000 0000 0001 0000
11	000B	0000 0000 0000 1011	0000 0000 0001 0001
12	000C	0000 0000 0000 1100	0000 0000 0001 0010
13	000D	0000 0000 0000 1101	0000 0000 0001 0011
14	000E	0000 0000 0000 1110	0000 0000 0001 0100
15	000F	0000 0000 0000 1111	0000 0000 0001 0101
16	0010	0000 0000 0001 0000	0000 0000 0001 0110
17	0011	0000 0000 0001 0001	0000 0000 0001 0111
18	0012	0000 0000 0001 0010	0000 0000 0001 1000
19	0013	0000 0000 0001 0011	0000 0000 0001 1001
20	0014	0000 0000 0001 0100	0000 0000 0010 0000
21	0015	0000 0000 0001 0101	0000 0000 0010 0001
22	0016	0000 0000 0001 0110	0000 0000 0010 0010
23	0017	0000 0000 0001 0111	0000 0000 0010 0011
24	0018	0000 0000 0001 1000	0000 0000 0010 0100
25	0019	0000 0000 0001 1001	0000 0000 0010 0101
26	001A	0000 0000 0001 1010	0000 0000 0010 0110
27	001B	0000 0000 0001 1011	0000 0000 0010 0111
28	001C	0000 0000 0001 1100	0000 0000 0010 1000
29	001D	0000 0000 0001 1101	0000 0000 0010 1001
30	001E	0000 0000 0001 1110	0000 0000 0011 0000
31	001F	0000 0000 0001 1111	0000 0000 0011 0001
•	•	•	•
•	•	•	•
•	•	•	•
63	003F	0000 0000 0011 1111	0000 0000 0110 0011
•	•	•	•
•	•	•	•
•	•	•	•
255	00FF	0000 0000 1111 1111	0000 0010 0101 0101
•	•	•	•
•	•	•	•
•	•	•	•
9999	270F	0010 0111 0000 1111	1001 1001 1001 1001

B.10 ASCII Codes

b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0	ASCII HEX code		Most significant digit 0	1	2	3	4	5	6	7
				0	0	0	0	Least significant digit	0	NUL	DEL	SPACE	0	@	P	‘	p
				0	0	0	1		1	SOH	DC_1	!	1	A	Q	a	q
				0	0	1	0		2	STX	DC_2	”	2	B	R	b	r
				0	0	1	1		3	ETX	DC_3	#	3	C	S	c	s
				0	1	0	0		4	EOT	DC_4	$	4	D	T	d	t
				0	1	0	1		5	ENQ	NAK	%	5	E	U	e	u
				0	1	1	0		6	ACK	SYN	&	6	F	V	f	v
				0	1	1	1		7	BEL	ETB	’	7	G	W	g	w
				1	0	0	0		8	BS	CAN	(	8	H	X	h	x
				1	0	0	1		9	HT	EM	)	9	I	Y	i	y
				1	0	1	0		A	LF	SUB	*	:	J	Z	j	z
				1	0	1	1		B	VT	ESC	+	;	K	[	k	{
				1	1	0	0		C	FF	FS	,	<	L	¥	l	|
				1	1	0	1		D	CR	GS	–	=	M	]	m	}
				1	1	1	0		E	SO	RS	.	>	N	^	n	~
				1	1	1	1		F	SI	US	/	?	O	_	o	DEL

Index

Numbers

1:1 communication
- computer link, 9 - 9
- general–purpose serial communication, 10 - 18
- specifications, 8 - 7, A - 7

1:N communication
- computer link, 8 - 2, 9 - 14
- general–purpose serial communication, 8 - 3, 10 - 34
- PLC link, 8 - 4, 11 - 2
- specifications, 8 - 7, A - 7

A

Absolute position control, 7 - 29
- programming example, 7 - 69

Analog potentiometer, 12 - 2

ASCII code table, B - 62

B

Backup battery, 5 - 10
- setting system registers, 5 - 11

Battery error alarm, 5 - 11

BCD code table, B - 61

Binary code table, B - 61

Booting time pulse output, 7 - 8

C

C–NET, 8 - 2

Capacitive load, 6 - 11

Circular interpolation (F176), programming example, 7 - 48

Clock/calendar function, 12 - 8

COM ports
- changing communication mode, 10 - 38
- communication cassette, 8 - 6
- specification with F159, 10 - 3

Command message, computer link, 9 - 3

Commands, computer link, 9 - 6

Communication. *See* Serial communication, Computer link, General–purpose serial communication, PLC link

Communication cassette, 1 - 5, 2 - 5, 8 - 5
- communication modes, 8 - 2
- computer link, 8 - 2
- general–purpose serial communication, 8 - 3
- installation, 8 - 10
- PLC link, 8 - 4
- specifications, 8 - 7
- types, 8 - 5
- wiring, 8 - 11

Communication mode, 8 - 2
- computer link, 9 - 9
- general–purpose serial communication, 10 - 4
- PLC link, 11 - 4

Communication status LEDs, 2 - 3

Computer link, 8 - 2, 9 - 2
- 1:1 communication, 9 - 9
- 1:N communication, 9 - 14
- command format, 9 - 3
- commands, 9 - 6
- connection example, 9 - 9, 9 - 18
- response message, 9 - 4
- system register settings, 9 - 7

Connection example
- computer link, 9 - 9, 9 - 18
- general–purpose serial communication, 10 - 18, 10 - 24
- PLC link, 11 - 15

Constants, B - 3

Control unit, 1 - 5
- dimensions, A - 9

Controllable I/O points, 1 - 6, 1 - 7

Current consumption, A - 3

CW/CCW output method, 7 - 27

D

Data table control (F174), programming example, 7 - 40

Decremental input, 7 - 9

Dimensions, A - 9

DIN rail attachment, 5 - 5

Direction output method, 7 - 27

E

Earthing. *See* Grounding

Elapsed value write and read instruction (F1), 7 - 14, 7 - 59

Emergency stop, programming example, 7 - 81

Emergency stop circuit, 6 - 2

Error, operation, 13 - 2

Error codes, B - 35

ERROR/ALARM LED, 13 - 4, 13 - 7

Expansion, restrictions, 1 - 6

Expansion unit, 3 - 2
- dimensions, A - 10
- installation, 3 - 3, 3 - 4
- parts, 3 - 5
- specifications, 3 - 6

F

F0
- high–speed counter function, programming example, 7 - 12
- pulse output function, programming example, 7 - 57

F1
- high–speed counter function, programming example, 7 - 14
- pulse output function, programming example, 7 - 59

F166, programming example, 7 - 16

F167, programming example, 7 - 17, 7 - 19, 7 - 22

F171 (home return), programming example, 7 - 33

F171 (trapezoidal control), programming example, 7 - 30

F172, programming example, 7 - 37

F173, programming example, 7 - 102

F174, programming example, 7 - 40

F175, programming example, 7 - 44

F176, programming example, 7 - 48

Features, 1 - 2

Flag operation in serial communication, 10 - 35

Flat type mounting plate, 5 - 6

FP–Sigma units, 3 - 4

FP0 units, 1 - 5, 3 - 3

FPWIN Pro conventions, B - 2

G

General–purpose serial communication, 8 - 3, 10 - 2
- 1:1 communication, 10 - 18
- 1:N communication, 10 - 34
- connection example, 10 - 18, 10 - 24
- flag operation, 10 - 35
- header, 10 - 35, 10 - 36
- programming example, 10 - 3, 10 - 10, 10 - 13
- receive buffer, 10 - 7
- receiving data, 10 - 3, 10 - 13, 10 - 33, 10 - 35
- sending data, 10 - 2, 10 - 8, 10 - 37
  - ASCII conversion, 10 - 32
- system register settings, 10 - 4
- terminator, 10 - 35, 10 - 36

Grounding, 6 - 2, 6 - 6

H

Header, general–purpose serial communication, 10 - 35, 10 - 36

Hexadecimal code table, B - 61

High–speed counter function, 7 - 2, 7 - 9
- control instruction (F0), 7 - 12
- elapsed value write and read instruction (F1), 7 - 14, 7 - 59
- specifications, 7 - 4, A - 6
- target value match OFF instruction (F167), 7 - 17
- target value match ON instruction (F166), 7 - 16

Home return, 7 - 29
- operation modes, 7 - 34
- programming example, 7 - 33, 7 - 72, 7 - 75
- types, 7 - 34

I

I/O allocation, 4 - 2
- FP–Sigma units, 4 - 3
- FP0 units, 4 - 5

Incremental input, 7 - 9

Incremental position control, 7 - 29
- programming example, 7 - 63, 7 - 66

Incremental/decremental control input, 7 - 10

Incremental/decremental input, 7 - 10

Inductive load, 6 - 10

Input modes, high–speed counter, 7 - 9

Input specifications, 2 - 6

Input wiring, 6 - 7

Installation, 5 - 2
- backup battery, 5 - 10
- DIN rails, 5 - 5
- expansion units, 3 - 3, 3 - 4
- flat type mounting plate, 5 - 6
- slim 30 type mounting plate, 5 - 8

Installation environment, 5 - 2

Installation space, 5 - 4

Instructions table, B - 37

Interlock circuit, 6 - 2

Internal circuit diagram, 2 - 7, 2 - 9, 2 - 10

J

JOG operation, 7 - 29
- programming example, 7 - 37, 7 - 78, 7 - 80

L

LEDs, 2 - 3

Limit switch, 6 - 9

Linear interpolation (F175), programming example, 7 - 44

Link area allocation, PLC link, 11 - 9

Link register, 11 - 3
- allocation, 11 - 9

Link relay, 11 - 3
- allocation, 11 - 9

M

Memory areas, B - 3

MEWTOCOL–COM, 9 - 2

MEWTOCOL–COM commands, B - 60

MIL connector, wiring, 6 - 12

Minimum input pulse width, 7 - 10

Monitoring, PLC link, 11 - 14

Mounting plate, 5 - 8

O

Operation on error, 13 - 2

Output specifications, 2 - 8

Output wiring, 6 - 10

P

Parts description, 2 - 2

Password function, 13 - 10

PC link. *See* PLC link

Photoelectric sensor, 6 - 7

PLC link, 8 - 4, 11 - 2
- connection example, 11 - 15
- monitoring, 11 - 14
- operation mode relay, 11 - 14
- largest station number, 11 - 13
- PLC link transmission error relay, 11 - 14
- response time, 11 - 18
- specifications, 8 - 9, A - 8
- SYS instructions, 11 - 20
- system register settings, 11 - 4
- transmission assurance relay, 11 - 14, 11 - 21
- transmission cycle time, 11 - 18, 11 - 20

Positioning, programming examples, 7 - 19

Positioning control instruction
- F171
  - home return, 7 - 33
  - trapezoidal control, 7 - 30
- F174, 7 - 40

Potentiometer, 12 - 2

Power failures, 6 - 2

Power supply, 6 - 3
- wiring, 6 - 4

Programming tools, 1 - 8

Protect error, 13 - 10

Proximity sensor, 6 - 7

Pulse output, control modes, 7 - 29

Pulse output function, 7 - 2, 7 - 26
- F0, 7 - 57
- specifications, 7 - 5, A - 6

Pulse output instruction
- F172, 7 - 37
- F175, 7 - 44
- F176, 7 - 48

Pulse output methods, 7 - 27

Pulse/direction output method, 7 - 27

PWM output function, 7 - 2, 7 - 102
- minimum input pulse width, 7 - 10
- specifications, 7 - 5, A - 6

PWM output instruction (F173), 7 - 102

R

Receive buffer, general–purpose serial communication, 10 - 7, 10 - 32

Reception done flag, 10 - 35

Reed switch, 6 - 8

Relay output specifications, 2 - 10

Relays, B - 3

Response message, computer link, 9 - 4

Response time, PLC link, 11 - 18

RUN/PROG. mode switch, 2 - 3

S

Safety measures
- installation, 5 - 2
- wiring, 6 - 2

Self–diagnostic error, 13 - 4, B - 36

Self–diagnostic function, 13 - 2

Send area allocation, 11 - 9

Send buffer, general–purpose serial communication, 10 - 32

Serial communication specifications
- 1:1 communication, 8 - 7, A - 7
- 1:N communication, 8 - 7, A - 7

Short–circuit protective circuit, 6 - 10

Slim 30 type mounting plate, 5 - 8

Special data registers, B - 20

Special internal relays, B - 13

Specifications
expansion unit, 3 - 6
general, A - 2
high–speed counter, A - 6
input, 2 - 6
output, 2 - 8
performance, A - 4
PLC link, A - 8
pulse output, A - 6
PWM output, A - 6
serial communication (1:1), A - 7
serial communication (1:N), A - 7
Start–up sequence, 6 - 2
Station number. *See* Unit number
Status indicator LEDs, 2 - 3
troubleshooting, 13 - 2
Syntax check error, B - 35
System registers, B - 6
setting, B - 7
table, B - 8
types, B - 6

T

Terminal block, wiring, 6 - 14
Terminal layout diagram
control units, 2 - 11
expansion unit, 3 - 8
Terminator, general–purpose serial communication, 10 - 35, 10 - 36
Tool port, 2 - 5
Transistor output specifications, 2 - 8
Transmission done flag, 10 - 35
Transmission error, 13 - 11
Trapezoidal control (F171), programming example, 7 - 30
Troubleshooting, 13 - 4
Two–phase input, 7 - 9
Two–wire type sensor, 6 - 8

U

Unit combinations, 1 - 6
Unit number
computer link, 9 - 15
PLC link, 11 - 5
Unit number setting switch, 2 - 4
computer link, 9 - 16
PLC link, 11 - 7
Unit types, 1 - 5

W

Watchdog timer, 13 - 7
Weight, A - 2
Wiring
communication cassette, 8 - 11
input, 6 - 7
MIL connector, 6 - 12
output, 6 - 10
power supply, 6 - 4
terminal block, 6 - 14

Record of Changes

Manual No.	Date	Description of changes
ARCT1F333E/ ACG–M333E	Sept. 2001	First edition
ARCT1F333V1.0END	Dec. 2001	European edition – addition of FPWIN Pro examples and procedures
ARCT1F333E–1/ ACG–M333E–1	Feb. 2002	2nd edition Additions: Control units – FPG–C32T2 – FPG–C24R2 Expansion unit – FPG–XY64D2T Tool software – FPWIN Pro Ver. 4
ARCT1F333V2.0END	April 2002	FPWIN Pro examples added for instructions F174, F175, F176
ARCT1F333V2.1END	July 2002	Correction of errors – programming example “Reading elapsed value (F1)” (pp. 7–15, 7–54) – programming examples F166 and F167 (pp. 7–16 ff.) – programming example “Double–Speed Inverter”, GVL (p. 7–22) – description F171, deviation counter clear signal (p. 7–34) – F173, PWM output function, note on out of range duty area (p. 7–74) – programming example F159, body (p. 10–14) – flag number R9049 changed to R9048 (p. 10–35) – command name SYS2 changed to SYS1 (p. 11–18) Additions – product numbers for power supply unit (p. 6–3) – F172, target value ranges (p. 7–37) – IEC addresses (appendix)
ARCT1F333E–2/ ACG–M333E–2	Nov. 2002	Additions – Control units – PNP output type FPG–C28P2 – Thermistor input function type (part numbers ending in TM) – Expansion units Add information about intelligent units
ARCT1F333V3.0END	May 2003	FPWIN Pro examples added to new sections Information on initial frequency of pulse output instructions added

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Rudolf–Diesel–Ring 2, D–83607 Holzkirchen, Tel. (08024) 648–0, Fax (08024) 648–111, www.mew–europe.com

■ **Austria** — **Matsushita Electric Works Austria GmbH**
Josef Madersperger Straße 2, A-2362 Biedermannsdorf, Austria, Tel. (02236) 2 68 46, Fax (02236) 46133, www.matsushita.at

■ **Benelux** — **Matsushita Electric Works Benelux B. V.**
De Rijn 4, (Postbus 211), 5684 PJ Best, (5680 AE Best), Netherlands, Tel. (0499) 37 2727, Fax (0499) 372185, www.matsushita.nl, www.matsushita.be

■ **France** — **Matsushita Electric Works France S.A.R.L.**
B.P. 44, F-91371 Verrières le Buisson CEDEX, France, Tél. 01 60 13 57 57, Fax 01 60 13 57 58, www.matsushita–france.fr

■ **Germany** — **Matsushita Electric Works Deutschland GmbH**
Rudolf–Diesel–Ring 2, 83607 Holzkirchen, Germany, Tel. (08024) 648–0, Fax (08024) 648–555, www.matsushita.de

■ **Ireland** — **Matsushita Electric Works UK Ltd. Irish Branch Office**
Waverley, Old Naas Road, Bluebell, Dublin 12, Republic of Ireland, Tel. (01) 460 09 69, Fax (01) 460 11 31, www.matsushita.ie

■ **Italy** — **Matsushita Electric Works Italia s.r.l.**
Via del Commercio 3-5 (Z.I. Ferlina), I-37012 Bussolengo (VR), Italy, Tel. (045) 675 27 11, Fax (045) 670 04 44, www.matsushita.it

■ **Portugal** — **Matsushita Electric Works Portugal España S.A. Portuguese Branch Office**
Avda 25 de Abril, Edificio Alvorada 5º E, 2750-512 Cascais, Portugal, Tel. (21) 482 82 66, Fax (21) 482 74 21

■ **Scandinavia** — **Matsushita Electric Works Scandinavia AB**
Sjöängsvägen 10, 19272 Sollentuna, Sweden, Tel. +46 8 59 47 66 80, Fax (+46) 8 59 47 66 90, www.matsushita.se

■ **Spain** — **Matsushita Electric Works España S.A.**
Parque Empresarial Barajas, San Severo, 20, 28042 Madrid, España, Tel. (91) 329 38 75, Fax (91) 329 29 76, www.matsushita.es

■ **Switzerland** — **Matsushita Electric Works Schweiz AG**
Grundstrasse 8, CH-6343 Rotkreuz, Switzerland, Tel. (041) 799 70 50, Fax (041) 799 70 55, www.matsushita.ch

■ **UK** — **Matsushita Electric Works UK Ltd.**
Sunrise Parkway, Linford Wood East, Milton Keynes, MK14 6LF, England, Tel. (01908) 231 555, Fax (01908) 231 599, www.matsushita.co.uk

North & South America

■ **USA** — **Aromat Corporation Head Office USA**
629 Central Avenue, New Providence, N.J. 07974, USA, Tel. 1–908–464–3550, Fax 1–908–464–8513, www.aromat.com

Asia

■ **China** — **Matsushita Electric Works, Ltd. China Office**
2013, Beijing Fortune, Building 5, Dong San Huan Bei Lu, Chaoyang District, Beijing, China, Tel. 86–10–6590–8646, Fax 86–10–6590–8647

■ **Hong Kong** — **Matsushita Electric Works Ltd. Hong Kong**
Rm1601, 16/F, Tower 2, The Gateway, 25 Canton Road, Tsimshatsui, Kowloon, Hong Kong, Tel. (852) 2956–3118, Fax (852) 2956–0398

■ **Japan** — **Matsushita Electric Works Ltd. Automation Controls Group**
1048 Kadoma, Kadoma–shi, Osaka 571–8686, Japan, Tel. 06–6908–1050, Fax 06–6908–5781, www.mew.co.jp/e–acg/

■ **Singapore** — **Matsushita Electric Works (Asia Pacific) Pte. Ltd.**
101 Thomson Road, #25–03/05, United Square, Singapore 307591,Tel. (65) 6255–5473, Fax (65) 6253–5689

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